Index Number CERCLA 02-2010-2017

REVISED DRAFT OU2 FEASIBILITY STUDY

SHIELDALLOY METALLURGICAL SUPERFUND SITE
NEWFIELD, NEW JERSEY

TRC Job No. 112434ES

Prepared by:

TRC Environmental, Inc.
57 East Willow Street
Millburn, NJ 07041

September 2013

TABLE OF CONTENTS

Attachment: CD of FS (in front pocket)

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

Index Number CERCLA 02-200-2017

Revised DRAFT OU2 FEASIBILITY STUDY
SHIELDALLOY METALLURGICAL SUPERFUND SITE
NEWFIELD, NEW JERSEY

1. INTRODUCTION

TRC Environmental Corporation (TRC) has prepared this Revised Draft Operable Unit 2 (OU2) Feasibility Study (Revised Draft OU2 FS) for the Shieldalloy Metallurgical Corporation (SMC) Superfund Site (Site), located at 35 South West Boulevard, Newfield, New Jersey (Figure 1). TRC Companies, Inc. and SMC executed the Administrative Order of Consent (AOC) for the Site with the U.S. Environmental Protection Agency (EPA) on April 28, 2010 in Newfield, New Jersey. TRC assumed the responsibility of completing the components of the AOC related to OU2. The AOC defines OU2 as soil, sediment, and surface water (not otherwise addressed by OU1, non-perchlorate groundwater, and OU3, perchlorate in all media. This Draft OU2 FS fulfills the requirement of the Order specified in Task VIII.

TRC has submitted the 2013 Draft Final Remedial Investigation Report prerequisite to this Draft OU2 FS. The OU2 RIR included the following integral components:

- OU2 Draft Final Baseline Ecological Risk Assessment (BERA); and
- OU2 Revised Draft Baseline Human Health Risk Assessment (BHHRA).

The USEPA is targeting September 2013 to complete a Proposed Plan. To accomplish this goal, TRC will incorporate USEPA comments on the Revised Draft FS into a Final FS within 30 days of receipt of USEPA comments on the Revised Draft FS, in accordance with the AOC.

The Draft OU2 FS was prepared in accordance with the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA, also known as Superfund), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), in compliance with the requirements of the National Contingency Plan (NCP: 40 CFR 300), and in compliance with the USEPA Office of Solid Waste and Emergency Response (OSWER), *Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (OSWER Directive 9355.3-01, USEPA, 1988a) herein referred to as "RI/FS Guidance". This RI/FS Guidance states that the FS related work can be initiated any time between the baseline risk assessment and the completion of the Draft RIR. Based on the work completed to date, there is sufficient information to proceed with the FS.

This Draft OU2 FS is organized as follows:

- Section 1 presents introductory information;
- Section 2 presents Site descriptions, environmental history, summary of contamination, applicable or relevant and appropriate (ARARs) and Preliminary Remedial Goals (PRGs);
- Section 3 summarizes the Remedial Action Objectives (RAOs), Remedial Volumes, General Response Actions (GRAs), and the Preliminary Engineering Considerations;
- Section 4 identifies and screens the remedial alternatives;
- Section 5 develops the alternatives;
- Section 6 presents the detailed analysis of alternatives
- Section 7 presents conclusions
- Section 8 presents references

Supporting figures, tables, appendices, and attachments are also included.

2. SITE DESCRIPTION AND HISTORY

The following topics are discussed in the following subsections:

- Site background;
- Site history;
- Summary of environmental site activities;
- ARARs/TBCs;
- Nature and extent of contamination;
- Summary of Baseline Risk Assessment;
- PRGs; and
- Fate and transport.

2.1 Site Background-- Location and Description

The SMC Facility ("Facility") is located at 35 South West Boulevard, primarily in the Borough of Newfield, Gloucester County, New Jersey. A small portion of the southwest corner of the Facility is located in the City of Vineland, Cumberland County, New Jersey. A site location map is provided on Figure 1. The SMC Facility comprises approximately 67.7 acres. The approximate center of the Facility is located at latitude 39°32'27.6"N and longitude 75°01'06.7"W. SMC also owns an additional 19.8 acres of farmland, referred to as the "Farm Parcel," located in Vineland, approximately 2,000 feet southwest of the Facility. SMC purchased the Farm Parcel to facilitate the installation and operation of a pumping well, which is part of a groundwater pump and treat remediation system. This Farm Parcel has never been used for manufacturing or related activities. The SMC Facility, the Farm Parcel, and OU2 are hereinafter designated as the "Site."

The Facility is currently used as office space and is sublet as warehousing for construction companies and the Newfield Borough. The Facility is bordered as follows:

- To the north by a former rail spur and a former landfill;
- To the west by Conrail rail lines, South West Boulevard, and various light industries and residences;
- To the east by a wooded area, residences and small businesses; and
- To the south by Hudson Branch stream, and the residences located along Weymouth Road.

The Facility is secured by a perimeter chain link fence. The facility parking lot along the western property boundary lies outside of the chain link fence to allow visitor and administrative access.

The OU2 RI indicated that OU2 is comprised of Facility Soils and Hudson Branch (sediment, soil, surface water). The OU2 RI studied other surface water bodies. The Facility and the surface water bodies are discussed in the subsections below.

2.1.1 Facility

To understand the nature of the Facility, and to assist in the remedial selection, it is helpful to understand certain subareas of the Facility, defined by the facility's historic operations, current land cover, and potential future uses. The Facility consists of six key areas, namely:

- Former Production Area,
- Former Lagoons Area,
- Eastern Storage Areas,
- Southern Area,
- Natural Resource Restoration Areas, and
- Restricted Area.

A description of the key areas is provided below. A site plan depicting the boundaries of these areas and the physical features of the facility areas is provided as Figure 2.

The Facility is zoned industrial. It is noted that SMC has stipulated, in a contract (an institutional control), that the Facility use will remain industrial only. Further, per contract, SMC must maintain existing fencing and cover/caps in the same manner as it existed in 2006. For example, should SMC remove a building, SMC will pave the former building footprint (to maintain the existing cover/cap). The SMC contract further stipulates that a deed notice, in the form required by New Jersey, be placed on the property, to the effects discussed above. This information is offered to be comprehensive, but, consistent with Superfund protocols, these current or future institutional controls do not factor into the risk evaluation.

2.1.1.1 Former Production Area

The Former Production Area is located in the northwest part of the Facility and is the area where the majority of former manufacturing activities occurred. The Former Production Area is approximately 22 acres, and is the largest Facility area.

The Former Production Area is largely covered with buildings and asphalt or concrete pavement. SMC uses one of the buildings as offices (D202). Current buildings used for storage include D117, D203(D), and D203(E). Building D203(B) is used as a break room. Building D204 is a former scale house, and building D203(C) houses a plumbing backflow preventer. Currently vacant buildings include D110, D116(D), and D115. Building D203(F) is currently leased to the Borough of Newfield for storage of municipal vehicles. Building D203(A) is currently leased to a construction company. Building D116(A) is currently leased to the Borough of Newfield Public Works. TRC uses Building D216 for the Wastewater Treatment Facility component of the OU1 pump and treat system.

Building D118(B), which includes the smoke stack, is currently vacant. This building was used by SMC for smelting of metals, including chromium. The smoke stack area was also historically used in association with previous glass manufacturing operations.

A former degreasing unit existed in the Former Production Area in former building D109 (this area is referred to as the Former Degreasing Area); it was in periodic service for approximately 2 years (1965-1967). After 1967, the system's operation was discontinued and the entire system was removed from the Site. Trichloroethene (TCE) was the primary degreasing chemical used in the unit.

The buildings located in the western portion of the Former Production Area were used for office space and warehousing. This area is largely covered by buildings and paving, which have been in place for a long time. The buildings and paving in this area provide protective cover. The groundwater chromium concentrations is this area are relatively low (generally approaching the EPA screening level), discussed in more detail in OU1 work documents.

SMC's future plans for the Former Production Area include the continued use of the buildings for warehousing and construction equipment storage space (or replacement/repair thereof, per current institutional control).

2.1.1.2 Former Lagoons Area

The Former Lagoons Area is located in the central portion of the Facility and occupies approximately 4.5 acres. The Former Lagoons Area includes closed lagoons that were used from the 1960s to the 1990s for wastewater treatment. During the 1960s, SMC used one unlined lagoon to hold untreated wastewaters. In 1971, this one unlined lagoon was closed and replaced by nine smaller, lined lagoons (B-1, B-2, B-3, B-5, B-6, B-7, B-8, B-11 and B-12) (see Figure 2). In 1987, the wastewater treatment process was modified with aboveground tanks replacing some of the lagoons in the wastewater treatment process. In May 1992, use of all nine lagoons was discontinued. The nine lagoons were characterized, remediated, and closed from 1994 to 1997. The closure activities were conducted in accordance with two closure plans, namely, the Closure Plan-Surface Impoundments B-1, B-2, B-3, B-5, B-11 and B-12 (TRC, 1995) submitted to the New Jersey Department of Environmental Protection (NJDEP) in August 1995; and Closure Plan-Surface Impoundments B-6-B-7, and B-8 that was submitted to the NJDEP in July 1997. NJDEP provided authorization to initiate the remedial action in a letter dated June 17, 1997.

Lagoon closure and remediation activities included sludge removal, liner removal, contaminated soil removal, post-excavation sampling, and backfilling with clean material. TRC performed and documented the sampling (TRC, 2000). Certain soil samples collected were below the water table (the saturated portions are now considered part of the OU1 investigation and remediation). The NJDEP approved the lagoons closure report and concluded that limited residual hexavalent chromium concentration in soils do not appear to represent a continued source of groundwater contamination (NJDEP, 2001).

Prior to their closure, the lagoons' effluent discharged via pipe with a discharge point into Hudson Branch along the Facility's southern fence line, generally at the western end of the broader area of Hudson Branch.

Two additional lined basins (B-9 and B-10) were located to the west of the former lagoons. These lined basins were used to contain wastewater associated with an air pollution control process. SMC stopped using the basins in the early 1990s. In December 1992, the soils below the basins and the adjacent berm soils were sampled per NJDEP requirements. The analytical results indicated that past activities did not impact the surrounding soils. The lined basins were closed in 1993 and the berm soils were used to backfill the former basins with clean material.

Currently, the Former Lagoons Area is covered by the backfill from lagoon closure, and light vegetation, which includes small trees and grass. SMC is considering a Brownfields/Brightfields approach for the Site, and is considering the Former Lagoons Area as the area to potentially receive a solar field. If viable, solar arrays would be placed in this area, after warranted remedial measures have been implemented.

2.1.1.3 Natural Resource Restoration Areas

The Natural Resource Restoration Areas cover totals approximately 9.65 acres, located in a non-contiguous collection of areas around the Facility, generally focused on the eastern and southern portions. The Natural Restoration Areas are overlain on other Facility Areas. The natural resource restoration caps were established by importing soil (generally a minimum of 1 foot thick, but as much as 2 foot thick), then establishing vegetation. Vegetation includes a variety of grass, flowers, trees, and bushes. In addition to providing natural resource value, these areas were intended as a cap to address potential soil contamination at these locations.

Natural Resource Restoration Areas were constructed in 1999 and 2000 at designated portions of the facility to provide habitat value. These Natural Resource Restoration Areas were based on a Natural Resource Restoration Plan prepared in October 1997 in accordance with the terms of EPA and NJDEP Environmental Settlement Agreement (ESA), which was incorporated into SMC's plan of reorganization pursuant to Chapter 11 of the Bankruptcy Code (US Bankruptcy Court, 1997). In November 1997, the Office of Natural Resource Damage (ONRD) reviewed and approved the Natural Resource Restoration Plan. The Pansy Field comprises an area south of the southern fence line, is approximately 2.2 acres and was previously used by local farmers to grow pansies.

To ensure the planted areas are maintained as vegetated areas, the future use of the planted areas is considered restricted. As such, the nature of these areas cannot be changed, without significant regulatory changes.

2.1.1.4 Eastern Storage Areas

The Eastern Storage Areas, which consist of two separate areas, are located to the east of the Former Production Area and Former Lagoons Area. These areas were previously used as the By-Product Drum Storage Area and a bone yard.

These areas have never included buildings or offices. Most of these areas were capped with the Natural Resource Restoration Tree Planting Area, so currently; the areas are mostly covered with vegetation.

There is a portion of the Eastern Storage Areas that is uncapped, which is approximately 1.3 acres and referred to as the “uncapped area,” an area which becomes notable based on the findings of the risk assessment work. This area is currently covered with some gravel and concrete debris.

SMC is considering this area for potential solar installation, or possibly continued use as storage.

During a site walk, the EPA noted that there were metallic discs on the ground surface in this area. SMC collected all visible discs, confirmed that they were steel “punchouts”, and properly disposed them.

2.1.1.5 Southern Area

The Southern Area is located north of the southern fence line of the Facility. The Southern Area includes undeveloped areas, the on-site impoundment and the Former Thermal Pond Area. The on-site impoundment, as referenced in the current New Jersey Pollutant Discharge Elimination System (NJPDES) permit, receives a combination of facility storm water and treated water from the on-site groundwater treatment system. The water from the on-site impoundment is directed into a ditch that flows into the Hudson Branch. The on-site impoundment was installed in the early 2000s by excavating into existing soils.

The Former Thermal Pond Area covers approximately 0.77 acres and consists of a rectangular depression, approximately 3-5 feet deep. The Former Thermal Pond Area was used on a few occasions as an emergency holding reservoir for treated wastewater. The Former Thermal Pond Area is currently covered with vegetation (grass and small trees). The outlet pipe is open, so only minor depths of water accumulate in the Former Thermal Pond. During drier seasons, the Formal Thermal Pond is dry.

Based on historical aerial photographs, some areas in the Southern Area were used for miscellaneous storage.

Currently, the Southern Area is covered with the vegetated cap that includes grass and small trees. Several areas were developed and included with the Natural Resource Restoration Tree Planting Area; these areas are shown on Figure 2.

Because of the nature of this area, SMC is currently planning no change in future site use.

2.1.1.6 Restricted Area

The Restricted Area is located in the eastern portion of the Facility and is referred to as a controlled area by the Nuclear Regulatory Commission (NRC). Due to the presence of naturally occurring thorium and uranium in the raw material used for ferro-columbium and the resulting slag and dust, this portion of the Facility is restricted.

A chain link fence with barbed wire surrounds this area (providing a second layer of security, within the Facility's perimeter fence). Additionally, the Restricted Area is posted with specific signage. Site personnel are trained to stay out of this area, unless specific training and/or escort is provided.

The Restricted Area is not the subject of the AOC and/or the OU2 Supplemental RI activities.

2.1.2 Surface Water Features

The surface water features appropriate to OU2 are:

- Onsite impoundment;
- Hudson Branch;
- Burnt Mill Pond; and
- Burnt Mill Branch.

These surface water features are discussed in the subsections below. Hudson Branch warrants more attention, so more substantial information on Hudson Branch is provided.

2.1.2.1. On-Site Impoundment

Facility storm water and treated water from the on-site groundwater treatment system is discharged to the On-Site Impoundment located near the southwest corner of the Facility. Currently, there are two permitted outfalls. DSN004A is the impoundment discharge into the ditch (which flows towards Hudson Branch), located at the southwest corner of the on-site impoundment. Flow is recorded with an H-flume located at the outfall. The other outfall (DSN001B) is located at the northwest corner of the on-site impoundment, and is the pump and treatment system's discharge point ("tailpipe") into the on-site impoundment.

2.1.2.2 Hudson Branch

Hudson Branch is perhaps the most important water body for OU2. The Hudson Branch description, solids, hydrology, vegetation/wetlands, and contaminant transport/deposition potential are discussed in the following subsections.

2.1.2.2.1 Hudson Branch Description

The surface water body immediately proximate to the Site is the Hudson Branch stream. The Hudson Branch is a small stream which originates just to the southeast of the Facility and flows west/southwest. Based on numerous site inspections, the Hudson Branch (near the Facility) is relatively dry during dryer periods of the year.

The channel of the Hudson Branch (as defined by top of bank or the presence of an ordinary high water mark, where no bank exists) is generally 1-3 feet in width. Along the southern boundary of the Facility, there is a 500 foot length of Hudson Branch that is broader in channel width (from 20 feet to 100 feet). It is believed that this broader area was created via excavation. The water depth in this portion of Hudson Branch ranges from zero feet (during dry periods) to approximately 3.5 feet deep. During normal flow periods, flow is generally confined to the channels. There is a culvert just downgradient of this broader area, which restricts flow during higher flow events. The drainage pipe from the areas of Newfield north of the Facility, discharges just upgradient of this culvert.

During higher-flow periods, flow swells to broader extents . The primary flow area is called the "channel", and the area outside of the channel is called "overbank".

Downstream of the SMC Facility, the Hudson Branch flows southwesterly, under South West Boulevard, Weymouth Road, Arbor Avenue, and North West Avenue (via culverts), then flow discharges into Burnt Mill Pond. The portion of Hudson Branch from the Facility to North West Avenue is considered Upper Hudson Branch, for purposes of the RIR; the portion of Hudson Branch from North West Avenue to Burnt Mill Pond is considered Lower Hudson Branch. There is an approximate 300 linear feet section of Hudson Branch that is broader (perhaps 75 feet wide) between Arbor Avenue and North West Avenue.

The Hudson Branch is classified as Fresh Water 2 (FW2), which is the general surface water classification applied to those fresh waters that are not designated as Fresh Water 1 (FW1) or Pinelands Waters (PL). In addition to the FW2 classification, the Hudson Branch is also designated as non-trout waters (NT).

The NJDEP identifies a delineated floodplain (as shown on the site plans) proximate to Hudson Branch in Newfield near the Facility. For purposes of the RI/FS, Hudson Branch is defined as the area within the floodplain of Hudson Branch (south of the Facility's southern fence line—areas north of the southern fence line are included in Facility Soils).

2.1.2.2.2 Hudson Branch Sediment

Sediment is defined in the EPA's "Terms of Environment" (http://www.epa.gov/roe/glossary.htm) as a "solid particle, generally derived from rocks and minerals, that is being transported or has been moved from its place of origin". This definition suitably accounts for what is actually a continuum of conditions proximate to the stream's fluctuating water line. The Hudson Branch floodplain limits, therefore, define where floodwaters exist and could potentially transport material. Therefore, solid material within the floodplain can be considered sediment. For purposes of understanding Site information, sediment may be referred to as one of three designations (dependent on sample location), namely, channel sediment (sediment within the Hudson Branch channel), wetland sediment (sediment over the banks of the channel but within the delineated wetland limit), or floodplain sediment (outside of the wetland limit, but within the floodplain limit). Solid samples associated with Hudson Branch which are outside of the floodplain are referred to as Hudson Branch soil. (Soils within the floodplain but within the Facility fencing are considered Facility Soil.)

The Cumberland County and Gloucester County Soil Surveys identify the vast majority of the area in and immediately around Hudson Branch as Manahawkin muck. Small portions of Hudson Branch are Woodstown-Glassboro complex. The Soil Surveys identify both of these matrices types as partially hydric (formed under conditions of saturation, flooding).

The RIR finds that the Hudson Branch sediments are silty with high organics, which is consistent with the descriptions in the county Soil Surveys. The matrix at deeper depths is described as sands and gravel.

2.1.2.2.3 Hudson Branch Hydrology

Runoff enters the Hudson Branch via overland flow and a number of culverts, including a north-south 36-inch diameter culvert that bisects the Site and conveys storm water from areas of Newfield north of the Site to Hudson Branch (into the broader area of Hudson Branch, just upgradient of the culvert that conveys Hudson Branch).

The RI determined that Hudson Branch along the Site's southern border is actually an intermittent stream, generally wet only during wet seasons. Hudson Branch from the Site to approximately the Farm Parcel has a hydraulic balance with the water table during some conditions (and can receive some discharge from groundwater in higher water table conditions). Hudson Branch from the Farm Parcel to Burnt Mill Pond is also either in balance with the water table or may receive water table discharge in higher water table conditions (TRC, 2012b).

As discussed in the OU2 RI, Hudson Branch's floodplain has been delineated by FEMA, near the Facility (2010), and near Burnt Mill Pond (1982). The floodplain depicted in the 2010 study is considerably broader than in the 1982 rendering, presumably because recent flood information shows a broader footprint than older studies. The older study indicates a floodplain averaging approximately 300' wide. The newer study shows the floodplain as wide as 1000'. For purposes of studying sample results, the floodplain limit between Burnt Mill Pond and the Facility is presumed to be 300' wide. This limit can be further studied during Remedial Design, as appropriate.

2.1.2.2.4 Hudson Branch Vegetation/Wetlands

Wetlands were delineated along the upper Hudson Branch per TRC's delineation report (TRC, 2012b). Multiple wetland habitats exist adjacent to the Hudson Branch, including the following palustrine wetland types: emergent marsh, broad-leaved deciduous forest, scrub-shrub, and open water. The width of the wetlands ranges from approximately 5 feet (along the generally dryer reach of Hudson Branch along the Facility boundary) to over 400 feet (near the southwest corner of the Facility). At a number of points along Hudson Branch, the wetland vegetation consists of monostands of vegetation that provides lesser quality habitat (i.e. monostands of phragmites). The limits of the wetlands and locations of the phragmites are shown in Figure 3. Wetlands vegetation (outside of the phragmites) includes combinations of overstory (red maple, pin oak, sweet gum, black willow, green ash, and white ash) with an understory (dominated by ferns).

Of the areas impacted with metals above risk criteria, which total 4.9 acres (as discussed in Section 3.2), the phragmites area comprises approximately 1.7 acres, and the higher quality habitat outside of the phragmites comprises approximately 3.2 acres.

It is noted that the wetlands were delineated after sample collection/analysis, but, as discussed in Section 4.2.3, the contamination is generally limited to the wetlands lateral boundary. Since the wetland delineation relies, in part, on hydrology/topography, and because hydrology/topography drives soil/sediment transport, this correlation follows sound science.

The "Federally Listed and Candidate Species Occurrences in New Jersey by County/Municipality" identifies a potential for the federally-listed threatened Knieskern's Beaked Rush (Rhynchospora Knieskiermii) to occur in the region and a potential for federally-listed threatened Swamp Pink (Helonias Bullata) to exist. However, the EPA notes (EPA June 14, 2013) that the existence of these animal and plant species at OU2 is unlikely due to the habitat requirement of these plant species.

2.1.2.2.4 Contaminant Transport/Deposition Potential

The RIR discusses, that some metals exist in the Hudson Branch sediment (in both channel and overbank areas). The stream characteristics, discussed above, help to understand the potential nature of sediment transport and deposition of Hudson Branch. A stream's transport/depositional potential is proportional to the size (and therefore energy) of the stream. Because Hudson Branch is a small stream, Hudson Branch's potential to transport/deposit is lesser than more substantial streams. Generally, where the channel (or wetlands or floodplain) is narrow, Hudson Branch will tend to have higher transport potential. Where the channel (or wetlands or floodplain) is broader, Hudson Branch will tend to have higher depositional potential.

2.1.2.3 Burnt Mill Branch (Background or Reference Stream)

Burnt Mill Branch (sometimes referred to as the Manaway Branch) generally flows north to south and discharges into Burnt Mill Pond. Burnt Mill Branch is located approximately 4,000 feet west of the Site. The headwaters of Burnt Mill Branch begin approximately 7,000 feet northwest of the Site. The Burnt Mill Branch continues from Burnt Mill Pond, joining the Maurice River approximately 9,000 feet southwest of Burnt Mill Pond. Burnt Mill Branch does not receive waters from the Site, and has been included in this study to represent *background conditions*.

The Burnt Mill Branch is classified as FW2, which is the general surface water classification applied to those fresh waters that are not designated as FW1 or PL. In addition to the FW2 classification, the Burnt Mill Branch is also designated as NT. These waters are generally not suitable for trout because of their physical, chemical, or biological characteristics, but are suitable for a wide variety of other fish species.

2.1.2.4 Burnt Mill Pond

Burnt Mill Pond is located approximately one mile and a quarter southwest of the SMC Facility and accepts discharge from Hudson Branch and Burnt Mill Branch. When Burnt Mill Pond is full, it is reported to be shallow, with a mean depth of 2.4 feet, and a surface area of approximately 15 acres in size. Burnt Mill Pond is impounded by a dam.

In 2011, the NJDEP's Dam Safety group indicated that the dam presented threat of failure and directed Vineland to drain the pond and study the dam. Burnt Mill Pond was drained during TRC's OU2 supplemental investigative field activities. At the time of the writing of this RIR, the pond remains drained.

2.1.3 Surficial Geology

Observations in numerous soil borings completed at the SMC Facility are consistent with the regional surficial geology. Three surficial geologic units underlie the Site, which include the Bridgeton Formation, Cohansey Sand Formation, and the Kirkwood Formation. The Bridgeton Formation consists of up to 28 feet of brown sand and overlies the Cohansey Sand Formation which is comprised of coarse sands and little silt in the upper 40 feet with generally finer sand and some clay and silt lenses in the lower 60-80 feet. Discontinuous silt and clay were encountered within the lower Cohansey Sand Formation. The Kirkwood Formation, predominantly a vertically confining gray clay and silt layer, was encountered between 121 to 153 feet below ground surface (ft bgs), underlying the Cohansey Sand Formation.

The thickness of the unsaturated soils at the Site ranges from a few feet (near the Hudson Branch) to 17 feet (in the northwest part of the Site). The surface soils and subsurface soils referred in this OU2 FS include the unsaturated soils (vadose zone). Saturated soils below the vadose zone are considered a component of OU1.

2.1.4 Bedrock Geology

Based on the average degree of dip for overburden in the Newfield area, it is estimated that the depth to bedrock beneath the Site to be approximately 2,000 ft bgs. Bedrock has not been encountered at the Site during previous investigations. Bedrock beneath the Site consists of banded, micaceous schists or gneiss within the Wissahickon Formation of Precambrian age. The Wissahickon Formation contains mica, quartz, feldspar, and chlorite with numerous fractures, joints, and folding of individual layers. The formation outcrops northwest of Gloucester County.

2.1.5 Local Hydrogeology

The principal aquifer in the vicinity of the Site is the Cohansey Sand, which is approximately 130 feet in saturated thickness. The Cohansey Sand is underlain by the Kirkwood Formation. The upper portion of the Kirkwood Formation is composed of silt and clay, which functions as a confining unit in the vicinity of the Site, restricting the downward flow of groundwater from the Cohansey Sand. Depths to groundwater across the Site range from surface grade at the Hudson Branch to 17 ft bgs in the northwest quadrant of the Site. Seasonal fluctuations in the water table elevations are on the order of a few feet. Groundwater flow direction in the Cohansey Sand is southwest, which closely matches general Site topography. The average linear on-site groundwater flow velocity in the shallow portion of the aquifer is about 2.9 ft/day (TRC, 2008). A downward hydraulic gradient has been observed in most on-site well clusters, which is consistent with groundwater pumping conditions at and downgradient of the Site.

Numerous groundwater monitoring wells located on the subject Site and on adjacent properties and roadside right-of-ways (ROWs) are utilized for continual groundwater monitoring.

2.2 Site History

Specialty glass manufacturing began at the Site in the early 1900s. SMC purchased the Site in the early 1950s. From 1955 to approximately 2007, SMC manufactured specialty steel and super alloy additives, primary aluminum master alloys, metal carbides, powdered metals and optical surfacing products at the Site. Past production processes also included chromium metal and chromium oxide, vanadium pentoxide and ferro-vanadium uranium oxide, thorium oxide, ferro-columbium, and columbium nickel.

Remedial investigations (started at the Site in 1972) identified chromium as the primary contaminant of concern in groundwater. Manufacture of chromium oxide was conducted in Department D106 until the late 1970s. Mixing of raw materials for production of chromium occurred in Department D102(A) and Department 112 was the site of crushing operations.

SMC made various forms of vanadium in the 1980s and mid-1990s. Vanadium-related production generally occurred in Building D111. The raw material was in the form of an ash, and was transported to the Facility via a variety of containers (e.g., sacks, drums, truck loads). The raw material was stored in the 3-sided "pole building" east of Building D111.

Chromium and vanadium are important compounds concerning OU2.

2.3 Summary of Environmental Site Activities

Extensive environmental activities have been occurring at the Site continually from the early 1970's to the present. Some of the major activities include:

- 1970's
  - Began environmental investigations;
  - Installed public water supply to area users;
  - Began operation of a pump and treat system;
- 1980s
  - ongoing groundwater studies and operation of pump and treat system;
- 1990s
  - Investigated OU2;
  - Closed and remediated the former lagoons (the primary source of chromium contamination to ground water) including excavation/disposal;
  - Installed the (9.65 acres) vegetated caps (part of the Natural Restoration regulatory process);
- 2000s
  - Executed a contract that ensures that existing caps (building/paving and vegetative) are maintained, and that an appropriate deed notice would be implemented;
  - Ongoing groundwater studies and operation of pump and treat system;
  - Progressive OU1 In Situ Remediation Pilot Program;
  - Constructed a modernized treatment plant;
  - OU2 Site Characterization Study Report (TRC, 2012);

- OU2 Baseline Ecological Risk Assessment (BERA, TRC 2013a); and
- OU2 Baseline Human Health Risk Assessment (BHHRA, TRC 2013b).

OU2 has an extensive site characterization. A summary of environmental activities conducted at the Site are provided in the subsections below for Facility soil and surface water bodies.

2.4 ARARs and TBC

This section provides a summary of the regulations that are considered ARARs to remediation of the Site. Both Federal and State environmental and public health requirements are considered.

2.4.1 Definition of ARARs

The statutory requirements that are directly relevant to the remediation of the SMC Site are identified and discussed using the framework and terminology of Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA). These acts specify that Superfund remedial actions must comply with the requirements and standards of both federal and state environmental laws.

The EPA defines applicable requirements as "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site." An applicable requirement must directly and fully address the situation at the Site.

The EPA defines relevant and appropriate requirements as "those cleanup standards, standards of control, or other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site."

Actions must comply with state ARARs that are more stringent than federal ARARs. State ARARs are also used in the absence of a federal ARAR, or where a state ARAR is broader in scope than the federal ARAR.

ARARs are not currently available for every chemical, location, or action that may be encountered. When ARARs are not available, remediation goals may be based upon other federal or state criteria, advisories and guidance, or local ordinances. In the development of remedial action alternatives, the information derived from these sources is termed "To Be Considered," or TBCs.

Remedial actions performed under Superfund authority must comply with ARARs except in the following circumstances: (1) the remedial action is an interim measure or a portion of the total remedy that will attain the standard upon completion; (2) compliance with the requirement could result in greater risk to human health and the environment than alternative options; (3) compliance is technically impractical from an engineering perspective; (4) the remedial action will attain an equivalent standard of performance; (5) the requirement has been promulgated by the State, but has not been consistently applied in similar circumstances; or (6) the remedial action would disrupt fund balancing.

ARARs and TBCs are classified as chemical-, action-, or location-specific. Chemical-specific ARARs or TBCs are usually health- or risk-based concentrations in environmental media (e.g., air, soil, water), or methodologies that when applied to site-specific conditions, result in the establishment concentrations of a chemical that may be found in, or discharged to, the ambient environment. Location-specific ARARs or TBCs generally are restrictions imposed when remedial activities are performed in an environmentally sensitive area or special location. Some examples of special locations include floodplains, wetlands, historic places, and sensitive ecosystems or habitats. Action-specific ARARs or TBCs are restrictions placed on particular treatment or disposal technologies. Examples of action-specific ARARs are effluent discharge limits and hazardous waste manifest requirements.

As specified in the 1988 Guidance (EPA, 1988), the preliminary identification of ARARs and TBC can assist in planning RI activities and performing certain data screening. The BERA and BHRRA each has rigorous EPA policies and procedures which must be followed, including initial screening and more detailed analysis of RI data.

2.4.2 Potential ARARs

2.4.2.1 Federal Contaminant-Specific ARARs/TBCs

Contaminant-specific ARARs can define acceptable exposure levels and be used in establishing preliminary cleanup goals. Contaminant-specific ARARs/TBCs, which may be applicable to the development of PRGs for OU2 media at the Site, are addressed below.

2.4.2.1.1 Soil

EPA Regional Screening Levels (SLs) for Industrial Soil (EPA, 2011a) are used for site "screening." The SLs for Industrial Soil will be applicable to the soils within the Facility. The EPA Regional SLs for Residential Soil will be considered for background soil samples. It should be noted that the SLs are based on human health risk and do not address potential ecological risk. SLs are not cleanup standards and should not be applied as such. The SL's role in site "screening" is to help identify areas, contaminants, and conditions that require further federal attention at a particular site. The SLs will be applicable to the soils, which are defined herein as the soils above the vadose zone.

2.4.2.1.2 Surface Water

The EPA National Recommended Water Quality (2009) and the EPA Region III Biological Technical Assistance Group (BTAG), Freshwater Screening Benchmarks, (EPA, 2006a) were selected as ARARs. EPA's compilation of national recommended water quality criteria is presented as a summary table containing recommended water quality criteria for the protection of aquatic life and human health in surface water for approximately 150 pollutants. These criteria are published pursuant to Section 304(a) of the Clean Water Act (CWA) and provide guidance for states and tribes to use in adopting water quality standards.

2.4.2.1.3 Sediment

EPA Freshwater Sediment Screening Benchmarks (Region III BTAG), (EPA, 2006b) were selected as sediment ARARs/TBCs for screening purposes.

2.4.2.2 Potential State Contaminant-Specific ARARs/TBCs

2.4.2.2.1 Soil

The NJDEP adopted Remediation Standards rules at N.J.A.C. 7:26D (2010). The soil remediation standards contained in those rules became effective on The June 2, 2008 Soil Remediation Standards (SRS) (NJDEP, 2008a) will be considered as ARARs/TBCs for screening purposes. Based on the existing and future use of the Facility (industrial), the NJDEP Non-Residential Direct Contact Soil Remediation Standard (NRDCSRS) will be considered for screening with respect to soil quality. NJDEP Direct Contact Soil Remediation Standards (RDCSRS) will be considered for screening for the wetland soils and background soil samples. The remediation standards will be applicable to the soils, which are here referred as the unsaturated soils above the vadose zone.

2.4.2.2.2 Sediment

The NJDEP's Site Remediation Program (SRP), Environmental Toxicology and Risk Assessment (ETRA) Unit has developed Ecological Screening Criteria from various sources to allow ease of reference for ecological screening criteria (ESC) for sediment (NJDEP, 2009). The ESCs are not promulgated standards, but are used herein as screening values.

2.4.2.3 Location-Specific ARARs/TBCs

The following are ARARs potentially applicable to OU2:

- The Endangered Species Act; and
- The National Historic Preservation Act.

The following are TBCs (non-promulgated items) potentially applicable TBCs for OU2:

- EPA's "Statement of Procedures on Floodplain Management and Wetlands Protection";
- Executive Order 11988 "Floodplain Management";
- Executive Order 11990 "Protection of Wetlands"; and
- EPA's 1985 "Statement of Policy on Floodplains/Wetlands Assessments for CERCLA Actions".

These location-specific ARARs/TBCs can be further considered in the FS and Remedial Design.

The EPA notes (EPA June 14, 2013) that there are no coastal barriers, coastal resources, wild and scenic rivers, wilderness areas, essential fish habitat, or significant agricultural lands in the vicinity of OU2. Therefore, the Coastal Barrier Resource Act, the Coastal Zone Management Act, the Wild and Scenic Rivers Act, the Wilderness Act, the Magnuson-Stevens Act and the Farmland Protection Policy Act are not ARARs/TBCs.

2.5 Nature and Extent of Contamination

Extensive investigations for OU2 have been performed, which have generated a robust body of data. The data were first compared to ARARs/TBCs. Then the risk assessments carefully evaluated the fate and transport of OU2, and resulted in the definition of Preliminary Remediation Goals (PRGs). Where Site media exceed PRGs, an actual or threatened risk is presumed to exist greater than specified EPA limits. In some cases in a few isolated locations in Facility Soils, as discussed in the RI, the soil exceeds ARARs in areas outside (but contiguous with) the PRG exceedances. These locations also require remediation, and are considered areas that must be addressed. The extent of contamination includes these areas, as well as areas that exceed PRGs.

A summary of the nature and extent of contamination for the two principal components of OU2, namely the Facility Soils and Hudson Branch, are discussed in the subsections, below. Figure 3 depicts the Site areas that require remedial attention.

The OU2 Supplemental RI results indicated that delineation of hexavalent chromium and vanadium in surface soils was completed to the north of the Eastern Storage Areas and near the property line.

Surface soil samples associated with the BERA sampling were also collected in this area. The analytical results for BERA soil samples RA-27 (BERA-SS-09), RA-34 (BERA-SS-10), RA-28 (BERA-SS-11), RA-32 (BERA-SS-12), RA-49 (BERA-SS-13), and RA-50 (BERA-SS-14) are provided in Table 11. Total chromium was detected in BERA samples at concentrations ranging from 2.3 mg/kg to 132 mg/kg. Vanadium was detected in the BERA samples at concentrations ranging from ND to 286 mg/kg, which are below the ARARs/TBC of 1,100 mg/kg. Vanadium soil results are shown on Figure 3.

2.5.1 Facility Soils

The following table provides an understanding of the Facility soil characterization by identifying the percentage of "hits" (i.e. detections above ARARs/TBCs) in site soils for key constituents of concern:

Parameter	Number of samples	Number of detections above Non-Residential ARAR/TBC	Percentage of detections above Non-Residential ARAR/TBC	Average "Hit" Concentration (mg/kg)	Non-Residential ARAR/TBC (mg/kg)
Hexavalent Chromium	196	28	14%	21	5.6
Vanadium	182	18	10%	2,600	1,100
Arsenic	165	2	1%	56.4	19
Semi-VOCs ***Benzo(a)pyrene***	48	1	2%	0.42	0.20
PCBs	64	1	2%	3.4	0.74
Pesticides ***4,4-DDT***	49	4	8%	33	8

Review of the table above indicates that hexavalent chromium and vanadium have the highest percent of detections above the ARAR/TBCs, but only 14% and 10%, respectively, exceed ARARs/TBCs.

Hexavalent chromium was detected in 28 of 196 (14%) samples collected at the SMC Facility exceeding the ARARs/TBC. The average hexavalent chromium "hit" concentration (21 mg/kg) is slightly elevated compared to the ARARs/TBCs of 5.6 mg/kg.

Vanadium was detected in 18 of 182 (10%) samples collected from the Facility at concentrations exceeding the ARARs/TBC. The average vanadium "hit" concentration (2,600 mg/kg) is above the NJDEP NRDCSRS of 1,100 mg/kg but below the EPA SLs for industrial soil of 5,200 mg/kg.

Arsenic was only detected in 2 out of 165 samples at concentrations exceeding the ARARs/TBC of 19 mg/kg, which is based on NJDEP's natural background. Arsenic exceedances (43.1 mg/kg and 69.8 mg/kg) were detected in samples obtained from the Former Production Area. Arsenic was also detected in the background samples at concentrations ranging from 2.4 mg/kg to 6.8 mg/kg. The arsenic exceedance in two samples would generally be considered de minimus.

VOCs were not detected above ARAR's/TBCs. VOCs are not considered a substantive issue in site soils.

Benzo(a)pyrene was only detected in 1 of 48 soil samples collected at the Facility above the ARARs/TBC of 0.2 mg/kg. The benzo(a)pyrene exceedance (0.42 mg/kg) was detected in one sample (SB-44) collected from the Former Production Area in 1990. In 1995, soil sample SB-44B was collected from the same location and depth interval and the analytical results indicated that no Semi-VOCs were detected in this sample. Semi-VOCs would generally be considered deminimus.

Total PCBs were only detected in 1 of 64 samples collected at the SMC Facility above the ARARs/TBC. The total PCB exceedance was detected in a sample collected from the Eastern Storage Areas at 3.4 mg/kg, which exceeded the ARARs/TBC of 0.74 mg/kg. PCBs would generally be considered deminimus.

Pesticides were only detected in 4 of 49 soil samples collected at the SMC Facility above the ARARs/TBC. The pesticides exceedances were detected in sample SB-73 collected from the Former Production Area and samples SB-20 and SB-22 collected from the Eastern Storage Areas in 1990. These locations were resampled (in 1995) and the analytical results indicated that pesticides were not detected. Accordingly, the initial hits are believed to be false positives.

These parameters identified above in Facility soils are discussed relative to PRGs in Section 5.0 and are analyzed in the Risk Assessments discussed in Section 6.0.

2.5.2 Hudson Branch

2.5.2.1 Hudson Branch Channel Sediment Sampling

Channel sediment samples were collected along Hudson Branch's centerline, from the "A" and "B" horizons (0 to 0.5 feet [ft] and 1.5 to 2.0 ft Below the Water-Sediment Interface [BWSI], respectively) at seven transects within the Hudson Branch. At certain transects, where Hudson Branch is broader, additional sediment samples were taken laterally (in 2011). Additional samples were collected from the "C" horizon (2.5 to 3.0 ft

BWSI) at certain stations to accomplish vertical delineation of metals. The 2011/2012 sampling provided the most extensive analyte list, which included the analysis for TCL semi-VOCs, TCL Pesticides/PCBs, TAL metals, pH, and ORP.

Solid samples associated with the BERA sampling were also collected from the shallow interval at stations in the Hudson Branch. The BERA samples were collected from the depth interval of 0 to 0.5 feet BWSI and analyzed for antimony, barium, beryllium, chromium, copper, lead, mercury, nickel, selenium, vanadium and zinc.

2.5.2.1.1 "A" Horizon Channel Sediment Samples

Semi-VOCs, pesticides, PCBs and metals were detected in channel sediment samples collected from the "A" horizon at concentrations exceeding the TBC.

A breakout of the "A" horizon sample results and detections above TBC for constituents of concern are included in the table below:

Parameter	Number of samples	Number of detections above TBC	Percentage of detections above TBC	Average "Hit" Concentration (mg/kg)	TBC (mg/kg)
Chromium	21	21	100%	2,868	26
Antimony	21	11	52%	18	2
Arsenic	14	3	29%	16	6
Cadmium	14	4	36%	2.5	0.6
Copper	21	19	90%	133	16
Iron	14	7	55%	30,600	20,000
Lead	21	16	76%	167	31
Manganese	14	1	7%	507	460
Mercury	21	15	71%	1.1	0.174
Nickel	21	20	95%	220	16
Zinc	21	11	52%	314	120
Semi-VOCs	13	11	85%	-	-
Pesticides	13	4	31%	-	-
PCBs	13	5	38%	0.32	0.0598

2.5.2.1.1.1 Metals

Based on the data for the Hudson Branch channel, chromium has the highest percent of detections above the ARAR/TBCs. Chromium (average exceedance of 2,868 mg/kg) was detected in all sediment samples collected from the depth interval of 0.0 to 0.5 ft BWSI exceeding the TBC of 26 mg/kg. The highest chromium concentrations (10,400 mg/kg) in Hudson Branch channel sediments occur near the south central portion of the Site, and generally decrease along Hudson Branch, moving downstream away from the Site. Further, concentrations tend to decrease after Hudson Branch flows through a culvert.

Other metals detected in shallow sediment samples exceeding the TBC included the following: antimony, arsenic, cadmium, copper, iron, lead, manganese, mercury, nickel, and zinc. Note that copper, iron, lead, manganese, mercury, nickel, and zinc were also detected in background sediment samples (in Burnt Mill Branch) exceeding the TBC. Average manganese and mercury concentrations were higher in background sediment samples.

2.5.2.1.1.2 Semi-VOCs, Pesticides, PCBs

Semi-VOCs, in particular polycyclic aromatic hydrocarbons (PAHs), were detected in 11 of 13 channel sediment samples exceeding the TBC. The highest concentrations were detected near the south central portion of the Site. Semi-VOCs (nine parameters) were also detected in background sediment samples exceeding the ARARs/TBC. Pesticides were detected in 8 of 11 channel sediment samples exceeding the TBC. PCBs were detected in 4 of 13 channel sediment samples above TBCs. PCB exceedances were detected in sediment samples collected south of the SMC Facility and just south to the intersection of South West Blvd. and Weymouth Road. PCBs were not detected in background sediment samples.

2.5.2.1.2 "B" and "C" Horizon Channel Sediment Samples

Semi-VOCs, pesticides, PCBs and metals were detected in channel sediment samples collected from the "B" horizon at concentrations exceeding the TBC. No exceedances were observed in samples collected from the "C" horizon, except for one sample with a hexavalent chromium concentration, just above the ARARs/TBC. Concentrations in deeper sediment samples were lower than those detected in the shallow interval ("A" horizon).

A breakout of the "B" and "C" horizon sample results and detections above TBC for the constituents of concern are included in the table below:

Parameter	Number of samples	Number of detections above TBC	Percentage of detections above TBC	Average "Hit" Concentration (mg/kg)	TBC (mg/kg)
Chromium	16	12	75%	419	451
Antimony	16	1	6%	10	2
Copper	16	1	7%	37.3	16
Lead	16	2	13%	71	31
Manganese	16	2	13%	1,735	460
Mercury	16	2	13%	0.64	0.174
Nickel	16	3	19%	67	16
Zinc	16	1	7%	199	120
Semi-VOCs	15	2	13%	-	-
Pesticides	15	3	20%	-	-
PCBs	15	1	7%	0.081	0.0598

Based on the data for the Hudson Branch, chromium has the highest percent of detections above the TBCs.

Chromium (average concentration of 419 mg/kg) was detected in 12 of 16 channel sediment samples collected from the "B" and "C" horizons at concentrations exceeding the TBC of 26 mg/kg. Sediment samples designated as "B" and "C" horizons were collected from the sand and gravel unit and from the silt/organic matter.

These results indicate that highest metal concentrations are present in the silt/organic matter that ranges from a few inches to two feet in thickness. Chromium results for channel sediment samples collected from the sand and gravel layer ranged from 2.3 mg/kg to 166 mg/kg. Chromium was also detected in background sediment samples at concentrations ranging from ND to 22.3 mg/kg.

A total of five Semi-VOC parameters, which consisted mainly of PAHs were detected in 2 of 15 sediment samples exceeding the TBC. The Semi-VOC exceedances were observed in one sample collected from the broader area, south of the SMC Facility and at downstream location (Station SD-23). Semi-VOCs were also detected in background sediment samples at higher concentrations, except for one parameter.

Pesticides were detected in 3 of 15 channel sediment samples exceeding the TBC and PCBs were detected in 1 of 15 channel sediment samples above TBCs of 0.0598 mg/kg.

A comparison of the shallow and deep sediment indicated that metal concentrations decrease with depth. Further, it is noted that concentrations are higher when the sediment matrix is more organic, and generally lower when the sediment matrix is granular. Generally, chemicals exist mostly within the top 6 to 24 inches of channel sediments.

2.5.2.2 Hudson Branch Wetland Sediment

Wetland sediment (outside of the channel, but within the wetlands) samples were collected at specific of locations (top of bank on each side of the stream for the seven transect lines) in the Hudson Branch.

Semi-VOCs, PCBs, pesticides, and metals were detected in several wetland samples exceeding the TBCs. The areas where samples exceed TBCs generally include the broader area of Hudson Branch, south of the site's southern fence line.

A breakout of the OU2 Supplemental RI results and detections above TBC for constituents of concern is included in the table below:

Parameter	**Number of samples**	**Number of detections above TBC**	**Percentage of detections above TBC**	**Average "Hit" Concentration (mg/kg)**	**TBC (mg/kg)**
Chromium	35	17	45%	1,163	26
Antimony	35	5	14%	14	2
Arsenic	35	3	9%	14	6
Cadmium	35	4	11%	2.3	0.6
Copper	35	5	14%	279	16

Iron	35	3	9%	32,433	20,000
Lead	35	11	31%	187	31
Manganese	35	2	6%	1,195	460
Mercury	35	10	29%	0.55	0.174
Nickel	35	9	26%	493	16
Zinc	35	4	11%	545	120
Semi-VOCs	17	6	35%	-	-
PCBs	17	2	11%	0.46	0.0598

An interesting correlation was observed related to the wetland sediment concentrations compared to wetland limits (the wetlands were delineated after overbank sediment sampling was completed). More specifically, 6 out of 7 Hudson Branch transects had at least one sample outside of the wetlands limit (transect 13 did not have one). In each of the 6 locations, the results for the samples outside of the wetlands limits are less than PRGs. This supports a finding that metals contamination is largely contained within wetlands.

2.6 Summary of Baseline Risk Assessment Findings

2.6.1 Baseline Ecological Risk Assessment

The OU2 Draft Final BERA evaluated potential ecological risk associated with Facility soil, Hudson Branch (and its wetland habitat), Burnt Mill Pond, the on-site impoundment, and the Former Thermal Pond. The BERA was conducted in accordance with EPA policy and guidance. A Screening Level Ecological Risk Assessment (SLERA) was completed and provisionally approved in 2011, and formed the basis of the BERA. Additionally, BERA Hudson Branch sediment toxicity testing and tissue sampling was performed for the Site, providing site-specific Contaminant of Potential Environmental Concern (COPEC)-receptor data.

2.6.1.1 Facility Soil Findings

For Facility soils, the BERA found no risk above established ranges for most parameters and receptors. The BERA found potential risk above established ranges only due to vanadium and chromium, based on the avian and mammalian insectivore foragers in the

Eastern Storage Area. However, the concentrations of chromium and vanadium in terrestrial invertebrates were poorly correlated with the surface soil concentrations of chromium and vanadium. Therefore, significant uncertainty is present regarding the proposed surface soil PRGs for chromium and vanadium and their usefulness in reducing risk to avian and mammalian insectivores that may forage within the Eastern Storage Area.

The Facility is zoned industrial and a deed notice will be filed for the Facility, both protective institutional measures. As mentioned earlier, Facility soil is not exposed, with the exception of part of the Eastern Storage Areas.

The extent of contaminants exceeding PRGs is presented in Section 2.7.

2.6.1.2 Hudson Branch Findings

For Hudson Branch, the BERA found no risk above EPA's accepted range for most parameters and receptors. The BERA found potential risk above EPA's accepted range to aquatic invertebrates and semi-aquatic wildlife (driven primarily by chromium, vanadium, copper, lead, and nickel) from Hudson Branch sediments. Further, the BERA found potential risk to avian and mammalian insectivores in Hudson Branch overbank soils primarily due to vanadium (and total chromium in some locations, generally closer to the Facility).

The BERA found that vanadium in Hudson Branch's surface water, although detected above a screening level threshold, are below less conservative effect levels, indicating that uncertainties are associated with the detected concentrations of vanadium within the surface water of the Hudson Branch.

2.6.2 Human Health Risk

2.6.2.1 COPCs/Exposure Assessment

The Site receptors included:

- Current/future recreational trespassers;
- Current on-site workers;
- Current/future utility and construction workers; and

- Future on-site residents.

Recreational Trespassers were evaluated for combined exposures to on-site and off-site surface soils, sediments (on-site impoundments, Hudson Branch Stream, and Burnt Mill Pond) and surface water (Hudson Branch Stream or Burnt Mill Pond). Current on-site workers and future on-site Residents were evaluated to on-site surface soils. Construction and Utility Workers were evaluated for exposures to combined surface/subsurface soils.

The Revised Draft OU2 BHHRA estimated exposure intakes and exposure parameters consistent with EPA guidance.

2.6.2.2 Toxicity Assessment

Both cancer and non-cancer health effects associated with the identified COPCs were obtained from appropriate sources, consistent with EPA policy and guidance, organized by Tier 1, Tier 2, and Tier 3 categories. COPCs with no toxicity information were carried through the risk evaluation and discussed in the uncertainty sections.

2.6.2.3 Risk Characterization

The results of the quantitative human health risk characterization are presented in two forms. In the case of human health effects associated with exposure to potential carcinogens, risk estimates incorporate age-dependent adjustment factors and are expressed as the lifetime probability of additional cancer risk associated with the given exposure. The cancer risk estimates are calculated as the cancer-based exposure intake (mg/kg-d) times the slope factor ($(mg/kg\text{-}d)^{-1}$). In numerical terms, these risk estimates are presented in scientific notation in this report. Thus, a lifetime risk of 1E-04 means a lifetime incremental risk of one in ten thousand; a lifetime risk of 1E-06 means an incremental lifetime risk of one in one million and so on. The estimated cancer risks are compared to risk values presented in the National Contingency Plan (NCP) (EPA, 1990). Specifically, for known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an additional cancer risk to a Reasonable maximum Exposure (RME) individual of between E-04 and E-06 (i.e. EPA's acceptable risk range).

For estimating risks to individual non-carcinogens, the Hazard Quotient (HQ) is used. The HQ is calculated as the non-cancer exposure intake (mg/kg-d) divided by the

Reference Dose (RfD) (mg/kg-d). Chronic RfDs are used for scenarios involving long-term exposures (i.e., industrial and residential). The HQs are summed across chemicals to calculate a Hazard Index (HI) for each pathway in each scenario. HIs that exceed available regulatory guidelines will be further evaluated by target organ and systemic effects.

The estimated non-cancer HIs are compared to available regulatory guidelines. Regarding non-carcinogenic health hazards, (EPA 1989) states that:

> "When the total hazard index for an exposed individual or group of individuals exceeds unity, there may be concern for potential non-cancer health effects."

Therefore, regarding non-carcinogenic health hazards, a HI equal to or less than one is within EPA's acceptable range (EPA 1989). The State of New Jersey has set acceptable non-carcinogenic risk for any given effect to a value not·to exceed a Hazard Index of 1.0. These established acceptable risk values are for any particular discrete contaminant and not for the cumulative effects of more than one contaminant (New Jersey Public Law P.L., 1993, c. 139 (NJSA58:10B).

Calculated risks are summarized below, for each receptor.

Summary of SMC OU2 BHHRA Results

Receptor	Cancer	Non-Cancer (HI)	Drivers (>1E-06 or >1)
Recreational Trespasser			
On-Site/Off-Site Surface Soil	**2E-06**	7.1E-02	none
On-Site Impoundment Sediment	**6E-06**	7.0E-02	Arsenic[1]
Hudson Branch Sediment	**3E-05**	1.2E-01	B(a)P, arsenic[1], chromium VI[2]
Hudson Branch Surface Water	**5E-06**	2.1E-02	Chromium VI[3]
Burnt Mill Pond Sediment	**8E-06**	1.2E-02	Chromium VI[2]
Burnt Mill Pond Surface Water	**5E-06**	1.9E-02	Chromium VI[3]
Total Recreational Trespasser-HB	**4E-05**	2.9E-01	B(a)P, arsenic, chromium VI
Total Recreational Trespasser-BMP	**2E-05**	1.7E-01	Arsenic, chromium VI
On-Site Worker			
On-Site Surface Soil	**1E-05**	2.8E-01	B(a)P, Arochlor 1248, arsenic[1]
Future On-site Resident			
On-Site Surface Soil - Adult	**1E-05**	6.6E-01	B(a)P, Arochlor 1248, arsenic[1], vanadium
On-Site Surface Soil – Child -RME	**5E-05**	**3.8E+00**	B(a)P, B(a)A, B(b)f, I(1,2,3-cd)P, Arochlor 1248, arsenic[1], chromium VI, (vanadium: non-cancer)
On-Site Surface Soil – Child -CTE	**1E-05**	8.2E-01	B(a)P, chromium VI
Current/Future Construction Worker			
Combined on-site surface/subsurface soil - RME	**2E-06**	**2.3E+00**	Vanadium
Combined on-site surface/subsurface soil - CTE	**1E-06**	**9.9E-01**	None
Current/Future Utility Worker			
Combined on-site surface/subsurface soil	**1E-05**	5.1E-01	Vanadium
	Bold	= > 1E-06 (cancer) or > 1 (non-cancer)	
	Bold	= > 1E-04 (cancer)	

[1]Note although arsenic risk exceeds 1E-06 the EPC < NJDEP background of 18 mg/kg
[2]Total chromium in sediment evaluated as chromium VI
[3]Chromium VI detection limit in surface water exceeded residential tap water screening criteria. Evaluated at ½ detection limit.

As indicated in the table above, all evaluated receptors demonstrated cancer risks that were within EPA's acceptable range, although cancer risk greater than 1E-06 was calculated for each of the receptors.

All receptors demonstrated a non-cancer HI below the target level of 1E+00 that EPA has identified in the NCP as representing an acceptable exposure level, with two exception, namely, the Future Child On-Site Resident Receptor and the Future Construction Worker Receptor. Vanadium in on-site soils drives the non-cancer hazard for Future On-Site Child Residents (surface soils) and Construction Workers (combined on-site surface/subsurface soils).

Although exposure to on-site surface soil shows a risk greater than the acceptable non-cancer threshold of 1E+00 to a Future On-Site Child Resident, it is noted as a matter of completeness, that the Site is zoned for industrial uses and will not be developed for residential use. Furthermore, a deed restriction will be applied to the Facility prohibiting its use for future residential development, and notifying construction workers of potential hazards. These and other remedial considerations will be further studied in the FS.

Therefore, this Revised Draft OU2 BHHRA concludes that OU2 human health risks are within EPA's acceptable range, except Facility soils for vanadium.

2.7 Development of PRGs

The Baseline Human Health Risk Assessment and the Baseline Ecological Risk Assessment were completed for the Site as summarized above. These risk assessments include Facility Soils and Hudson Branch.

2.7.1 Facility Soils

2.7.1.1 Baseline Human Health Risk Assessment

The BHHRA calculated risk for Facility soils is within EPA's acceptable risk ranges for both cancer and non-cancer concerns, for all parameters, except vanadium. Vanadium's calculated risk exceeded the EPA's acceptable risk range in only two exposure scenarios for Facility Soils. First, the non-cancer hypothetical future child resident scenario, included to provide a broad range of exposure scenarios, exceeds EPA's acceptable risk range, primarily driven by vanadium. Second, the non-cancer future construction worker scenario exceeds EPA's acceptable risk range, driven by inhalation of vanadium (as calculated by vanadium pentoxide) impacted construction dust.

Based on the results of the BHHRA, demonstrated human health risk has been established for the Facility Soil. The proposed human health PRG is:

- Vanadium- 457 mg/kg.

Other Parameters

Other parameters, including metals, VOCs, semi-VOCs, and PCBs/pesticides analyzed in Facility soils, as discussed in the RI do not present risk above EPA's acceptable risk range.

2.7.1.2 Baseline Ecological Risk Assessment

The BERA calculated risk for Facility soils which is within EPA's acceptable risk range for all parameters except vanadium and chromium. The BERA calculated risk above EPA's acceptable risk range in the Facility Soils is driven by total chromium and vanadium, based on the terrestrial insectivores' exposure scenario.

The proposed ecological PRGs for Facility Soils are as follows:

- Chromium- 44.4 mg/kg; and
- Vanadium- 52.5 mg/kg.

Other Parameters

Other parameters, including metals, VOCs, semi-VOCs, and PCBs/pesticides analyzed in Facility soils, as discussed in the RI do not present risk above EPA's acceptable risk range.

2.7.1.3 ARARs

The RI found that there were three data points for Facility Soils where there were ARAR exceedances outside of the footprint of PRG exceedances (SB-106, SB-98, and B11-S4). Specifically, these were exceedances of the hexavalent chromium ARAR. These four points collectively represent a very small area (less than one tenth of one acre). The area represented by these three points must be addressed by the Site remedy, and are included in the potential remedial quantities.

2.7.1.4 Combined Facility Soil PRGs

The PRGs for Facility Soils, are the most stringent of PRG or ARARs with exceedances outside of PRG. So the PRGs are 44.4 mg/kg for chromium (total), 20 mg/kg for chromium (hexavalent), and 53.5 mg/kg for vanadium.

2.7.2 Hudson Branch

2.7.2.1 Baseline Human Health Risk Assessment

The risk assessment work determined that semi-VOCs, pesticides, PCBs, and metals did demonstrate calculated risk above EPA's acceptable range. In fact, no parameter in Hudson Branch demonstrated calculated human health risk above EPA's acceptable range.

2.7.2.2 Baseline Ecological Risk Assessment

Certain metals, namely total chromium, vanadium, copper, lead and nickel demonstrate calculated *ecological* risk above EPA's accepted range, at certain parts of Hudson Branch.

The PRGs for the Hudson Branch are as follows:

	Sediment (mg/kg)	**Soil (outside of floodplain) (mg/kg)**
Chromium	1,275	157
Vanadium	574	32
Copper	222	No PRG
Lead	203	No PRG
Nickel	107	No PRG

Vanadium in Hudson Branch surface water also demonstrated risk above EPA criteria. However, the RI determined that the vanadium in surface water is attributable to the higher vanadium concentrations in sediments, so no PRG fir surface water was calculated.

2.8 Fate and Transport

The OU2 fate and transport mechanisms have been studied extensively as part of the BHHRA and BERA. The risk assessment work analyzes the various mechanisms and receptors, and quantified respective risk.

2.8.1 Facility Soils

The vast majority of Facility soils are covered by impervious surfaces (buildings or paving), or a vegetated cap (except the uncapped portion of the Eastern Storage Areas). The existing covers/caps prevent direct contact and limit contaminant transportation.

As discussed in the OU2 RI (Section 4.2.6), certain metals in Facility Soils that exhibited a potential for impact to groundwater were assessed. The OU2 RI found that arsenic, cadmium, lead, mercury, and silver in facility soils are not adversely impacting groundwater. Beryllium, nickel and manganese in facility soils may be affecting groundwater locally (under the Facility). However, Site data indicates that beryllium and nickel are attenuated in groundwater under the facility, and that manganese attenuates in groundwater (prior to reaching the Farm Parcel). Aluminum may also be impacting groundwater locally. Aluminum is detected in upgradient groundwater at a concentration of approximately 1,000 ppb, which is above groundwater *secondary* MCL concentrations (200 ppm, which is based on the aesthetics of water color). It is noted that the EPA uses a tap water health-based screening criterion of 1,600 ppb (significantly higher than the 200 ppm secondary MCL). Site data indicates that aluminum attenuates to the health based standard before reaching the Farm Parcel. Antimony may also be impacting groundwater locally.

Vanadium does not have an IGW TBC, but vanadium's potential IGW was studied because of the importance of vanadium at the Site. Vanadium in soil may be impacting groundwater locally (under the Facility), but vanadium attenuates in groundwater (before reaching the Farm Parcel).

Manganese, antimony, aluminum and vanadium may be incorporated into the OU1 in situ program to further assess the ability to naturally attenuate in groundwater.

2.8.2 Hudson Branch

Hudson Branch sediments can potentially be transported by erosive forces from the surface water. However, OU2 RI findings indicate that the vast majority (99%) of metals volume has been retained in the Upper Hudson Branch via natural deposition forces (discussed in Section 2.1.2.2.4).

3. RAOs, REMEDIAL QUANTITIES, GRAs AND PRELIMINARY ENGINEERING CONSIDERATIONS

The Remedial Action Objectives (RAOs), General Response Actions (GRAs), potential remedial quantities, and some preliminary engineering considerations are discussed in the subsections below.

3.1 Remedial Action Objectives (RAOs)

The RAOs for the Site are:

- Prevent (current and future) human exposure (direct contact and ingestion) to contaminated onsite soils above levels that pose an unacceptable risk for industrial use;
- Prevent (current and future) exposure to contaminated onsite soils above levels that pose an unacceptable ecological risk; and
- Prevent future exposure to contaminated sediment and surface water above levels that pose an unacceptable ecological risk, with consideration of the net ecology benefit.

The GRAs to help achieve these RAOs are discussed below.

3.2 Potential Remedial Quantities

The remedial quantities (*e.g.* areas and volumes) are discussed in the subsections below for the Facility Soils and Hudson Branch.

3.2.1 Facility Soils

As discussed in Section 2, vanadium and chromium exceed PRGs in Facility soils. The total area of PRG exceedance is approximately 30 acres. Also discussed in Section 2, most of the Facility soils are covered (either by buildings/paving or a vegetated cap) which reduces/eliminates key exposures. The Facility area identified as having PRG exceedances but no appropriate cover is in a specific portion of the Eastern Storage Areas. More specifically, there is a 1.3 acre portion in the Eastern Storage Areas that is uncapped. The volume of soil potentially affect in the Eastern Storage Areas is approximately 21,000 cubic yards (CY), assuming an approximate unsaturated soil depth of 10 feet.

3.2.2 Hudson Branch Sediments

As discussed in Section 2, metals (chromium, vanadium, lead, copper, and nickel) exceed PRGs in channel, wetland and floodplain sediments of the Hudson Branch. Metals concentrations extend to a depth of 0.5-2' BGS in Hudson Branch. This area comprises up to approximately 4.9 acres, and 9,600 CY. Of the 4.9 acres, approximately 1.7 acres are vegetated with phragmites, and 3.2 acres have higher quality habitat.

Greater than 98% of metal mass in Hudson Branch exists from the midpoint location of the Facility's southern fence line to a point just upstream of the Farm Parcel. The RAOs target mass reduction. Accordingly, the remedial efforts could focus on the areas of Hudson Branch containing the vast majority of mass.

3.3 General Response Actions (GRAs)

GRAs are categories of measures that can be applicable to accomplish the Site's RAOs. Superfund requires that an array of actions/alternatives be considered for subject media. GRAs describe broad classes of actions that satisfy the RAOs and form the foundation for the identification and screening of remedial technologies and alternatives.

The GRAs that are applicable to achieve the RAOs for the Eastern Storage Area Soils are:

- No Action;
- Engineering/Institutional Controls;
- Containment;
- Disposal;
- Treatment

The GRAs that are applicable to achieve the RAOs for the Hudson Branch Sediments are:

- No Action;
- Engineering Controls
- Disposal;
- Disposal and Containment;
- Containment;
- Treatment

GRAs include no action, institutional controls, stream monitoring Natural Recovery, engineering controls, removal, in-situ or ex-situ treatment and disposal. The no action, institutional controls, and disposal alternatives will be discussed in the remedial alternatives development and screening sections of the FS.
These GRAs are described in the subsections below.

3.4 Preliminary Engineering Considerations

The OU2 FS considered certain engineering aspects in the development and evaluation of remedial alternatives. Some of those aspects are initially discussed here, and then further considered during remedial alternative development and evaluation (Sections 5 and 6).

This document considers, at a level appropriate to an FS, certain preliminary engineering considerations, both in assembling and evaluating remedial alternatives. Preliminary engineering considerations are site-specific. Preliminary engineering considerations for this Site include Remedial Design (RD) and Remedial Construction (RC), land use considerations, stream area adaptive management and net-benefit considerations, data management, and waste management.

The Remedial Design will consider these, and additional aspects, as the concepts are better defined and advanced in the Remedial Design stage.

3.4.1 Remedial Design and Remedial Construction

In general, remedies involve a remedial design and a remedial construction phase (i.e. the alternatives “no action” or “institutional controls” generally do not). For example, a Remedial Design (RD) will be performed to develop drawings detailing the required work. The RD will evaluate the engineering elements in detail, including but not limited to geotechnical, grades/slopes, and wetland issues. The RD may or may not entail certain pre-design studies.

Remedial construction will generally entail mobilization, execution of the work, quality assurance, and project management. The scale and schedule of the remedial construction will vary based on the alternative (as discussed in the evaluation of each alternative). Following Remedial Construction, a report will be written summarizing the activities and a maintenance plan for the Site, if appropriate, can be developed.

3.4.2 Land Use Considerations

Land use considerations are integral to stream projects. Specifically, Hudson Branch is a delineated wetland and is within a delineated floodplain. Remedial Construction activities in the Hudson Branch potentially trigger land use regulations. For instance, wetlands that are disturbed will require the appropriate degree of restoration. Further, Remedial Construction will likely trigger Erosion and Sediment control requirements (including the discharge of construction dewatering). The Remedial Design will also identify what, if any, permits may be considered to support remedial construction, including land use permits. In the event that local or state permits may be applicable, Superfund reserves the right to obtain "Permit Equivalences". The RD will identify appropriate permits or permit equivalencies. Following the Remedial Design, permit equivalence applications will be made, as appropriate.

Because Hudson Branch activities would occur in a floodplain, the FS considered the basic requirement that filling a flood plain is not allowed. Excavation, then backfill, to at or below existing grades is permitted, because the floodplain storage is not impaired. This is called "no net fill". The FS considered "no net fill" requirements in the analysis of Hudson Branch alternatives. Facility Soil alternatives do not require work in the floodplain, so "no net fill" requirements do not apply to Facility Soil. Similarly, the FS included wetlands restoration.

3.4.3 Stream Capping

Based on EPA guidance, as of 2004, in-situ capping has been selected as a component of the remedy for contaminated sediment at approximately fifteen Superfund sites. At some sites, in-situ capping has served as the primary approach for sediment, and at other sites it has been combined with sediment removal (i.e., dredging or excavation) and/or monitored natural recovery (MNR) of other sediment areas.

Capping is sometimes considered following *partial* sediment removal where capping alone is not feasible due to a need to preserve a minimum water body depth.

EPA guidance *[Assessment and Remediation of Contaminated Sediment (ARCS) Program Guidance for In-Situ Subaqueous Capping of Contaminated Sediments* and the *Assessment and Remediation of Contaminated Sediments (ARCS) Program Remediation Guidance Document*] (EPA 1998) indicates that stream sediment sites conducive to in-situ capping includes sites where:

- Suitable types and quantities of cap material are readily available.

- Water depth is adequate to accommodate cap with anticipated uses (e.g., navigation, flood control).
- Long-term risk reduction outweighs habitat disruption, and/or habitat improvements are provided by the cap.
- Contamination covers contiguous areas (e.g., to simplify capping).

Further, EPA (EPA 1998) indicates that, an advantage of a stream sediment cap could be that changes in bottom elevation caused by a cap may create more desirable habitat, or specific cap design elements may enhance or improve habitat substrate.

3.4.4 Stream Area Adaptive Management and Net-Benefit

The EPA indicates (EPA 2005) that an "adaptive management" approach should be taken for stream remediation sites. Adaptive management refers to the decision making process of a stream remediation, using a flexible approach, based on the information obtained along the iterative nature of a stream remediation, to select and adjust remedies. The guidance also says that a stream remediation project should "Implement a cost-effective remedy that will achieve long term protection while minimizing short term impacts." The OU2 FS also refers to this as the "net benefit" consideration.

The ACOE supports the adaptive management approach, indicating in Technical Guidelines for Environmental Dredging of Contaminated Sediments (ACOE 2008) that practical limitations of stream sediment/soil removal should be "considered carefully...in developing performance standards. The use of newly developed equipment, adaptive management, etc. should result in improved performance." Further, the ACOE suggest that stream remedial decisions are "developed by weighing a number of factors…related to effectiveness, implementability, and cost for potential remedies." (ACOE 2008). Further the ACOE indicates that "continuous gathering and review of performance data, followed by real-time method adjustments to improve the effectiveness of the remedial action." This may be very applicable during the Remedial Design and Remedial Construction phases.

For example, a combination of proposed stream remedies, such as removal and capping and MNR could be implemented to achieve an adaptive management approach that provides the proper net benefit. Further, net-benefit is built into the RAOs that target the greatest mass of metals in Hudson Branch (*e.g.* pursuing areas of highest metals mass would maximize the mass recovered per area of habitat disturbance whereas pursuing areas of lower metal mass would recover minor mass with a high degree of high habitat disturbance).

3.4.5 Data Management

With most environmental cleanup sites, particularly with Superfund sites, a significant amount of environmental data is accumulated. The OU2 RI has already assembled a significant amount of data. Proposed activities might require pre-design work or post-remedial sampling that could generate additional data. The application of scientifically supported and regulatory supported statistical methods during design/remediation is essential. For example, in September 2012, the NJDEP published the "*Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria.*" Basically, this method suggested the development of geometric shapes to be overlain onto the site, and using Site data within the defined shapes to calculate data averages that can be compared to Site criteria. During pre-remedial or remedial measures, when data is taken, the application of the NJDEP methods, or other available methods at that time should be applied to support remediation.

Similarly, the ACOE (ACOE 2008) indicates that surface-weighted average concentration (SWAC) should be considered during remediation.

3.4.6 Waste Management

Response actions that include removal/excavation often have to consider waste management as part of the remedy. Sometimes, excavated material is kept onsite, such as under a cap. Other times, as appropriate, excavated material is disposed offsite. Waste needs to be managed pursuant to the appropriate application of Resource Conservation and Recovery Act (RCRA). For example, excavation in the Hudson Branch could generate waste. The waste could potentially be considered hazardous or non-hazardous. For example, solids from Hudson Branch impacted with metals may (or may not), without proper handling/treatment, present characteristics of a hazardous waste, according to RCRA. Specifically, if excavated material is subject to the aggressive acid digestion [the Toxicity Characteristic Leaching Procedure. (TCLP)] and the leachate exceeds 5 mg/l for chromium or lead, then that material is a media that "contains" hazardous waste. However, certain treatment could eliminate the characteristic nature and render the media non-hazardous. Treatment in-situ, which means within the contiguous area of contamination, would not require a RCRA Permit.

As part of the FS, TRC screened Hudson Branch sediments for TCLP characteristics and determined that the material exhibits no hazardous characteristics. Information is included in Appendix A. This can be further considered during the Remedial Design.

Waste management principles will be included in the alternatives and their evaluation. For purposes of the FS, alternatives including excavation of sediments, a certain percentage of disposed quantities are assumed to have hazardous characteristics, to be conservative in approach and costing. Materials assumed to have hazardous characteristics are assumed to be treated onsite via in situ stabilization to render the sediment non-hazardous.

4 IDENTIFICATION AND SCREENING OF TECHNOLOGIES AND REMEDIAL ALTERNATIVES

Remedial alternatives have been assembled, working from the GRAs discussed in Section 3.0, to provide an array of approaches. Remedial alternatives have been developed for the Site areas targeted for remediation, namely the Facility Soil and the Hudson Branch, as discussed in the subsection below.

These remedial alternatives for Facility Soil are conceptually depicted in Figure 4. The remedial alternatives for Hudson Branch are conceptually depicted in Figure 5.

4.1 Remedial Technologies/Options

4.1.1 No Action

The "no action" alternative serves as the baseline for comparison with other alternatives, and is required by Superfund guidance. In this alternative, no action is taken so impacts remain without additional treatment, control or monitoring.

4.1.2 Institutional Controls

Institutional controls are non-engineered instruments, such as administrative and legal controls, that help minimize the potential for human exposure to contamination and/or protect the integrity of the remedy.

As discussed in Section 2, there is a contract with SMC indicating that the Facility will remain industrial, that building/paved areas remain impervious, and that the Facility will receive an appropriate deed notice. Continuing maintenance will assure that they remain effective in preventing direct contact with human and ecological receptors. This contract is an example of an existing institutional (legal) control. While this contract is an institutional control, a government-supported deed notice for the Facility is an example of an institutional control that would be more protective and applicable. For example, a proposed Deed Notice for the Facility could stipulate that the Facility remains industrial use and, further, that certain activities (such as excavation) require appropriate regulatory involvement and worker/public protection.

4.1.3 Stream Monitoring

Stream monitoring generally includes the inspection and appropriate sampling of a stream over time to measure the advancement of natural remediation of contaminated sediment (employing naturally occurring processes to contain, or reduce the bioavailability or toxicity including but not limited to sorption, exposure reduction, biotransformation, diffusion, dilution, chemical destruction). Some examples of potential monitoring may include biota population assessments, toxicology testing of plant/animals, or chemical testing of sediments.

In EPA's contaminated sediment remediation guidance (EPA 2005), the EPA refers to this kind of monitoring as Monitored Natural Recovery (MNR). EPA indicates that "project managers should evaluate each of the three potential remedy approaches (sediment removal, capping, and [Monitored Natural Recovery]) at every sediment site." Sediment removal and capping are discussed below.

4.1.4 Engineering Controls

Engineering Controls are physical (or "engineered") measures that are physical barriers or structures designed to control or limit exposure to the contamination. Engineering controls can include fencing and capping. Fencing can reduce access to the fenced area, which limits contact and exposure. The objectives of containment are to limit the mobility of waste constituents and prevent inadvertent direct contact with waste materials. Several remedial technologies are available to implement this General Response Action.

Capping provides a physical barrier between contaminated material and potential exposure pathways.

Containment of waste fill may be accomplished through capping/covering technologies. Covering typically includes site clearing and possibly grading to facilitate drainage, followed by placement of one or more layers of "clean" material to prevent direct contact with contaminated soil/fill and to prevent erosion and off-site transport of contaminated soil particles. Covering also performs the additional function of reducing infiltration. Covering may potentially follow excavation and consolidation of soil/fill if contamination is spotty or spread across large areas.

For the Facility soils, capping may include some appropriate combination of earthen materials (soil/gravel) and/or geosynthetics (*e.g.* filter fabric). EPA reports (EPA Superfund Remedy Report, 2010) that 65% of Superfund RODs include some form of containment and/or engineering control as an integral component of the remedy.

For streams sediments, such as Hudson Branch, EPA's sediment remediation guidance (EPA 2005) defines sediment capping as "covering or cap of clean material over contaminated sediment that remains in place. Caps are generally constructed of clean sediment, sand, or gravel, but can also include geotextiles". The EPA sediment remediation guidance indicates that sediment capping can provide:

1) Physical isolation of the contaminated sediment sufficient to reduce exposure due to direct contact and to reduce the ability of burrowing organisms to move contaminants to the cap surface;
2) Stabilization of contaminated sediment and erosion protection of sediment and cap sufficient to reduce resuspension and transport of contaminants into the water column; and
3) Chemical isolation of contaminated sediment sufficient to reduce exposure from dissolved contaminants that may be transported into the water column.

Hudson Branch capping could include an appropriate soil/vegetated cover for the capping of the wetlands and floodplain sediments.

4.1.5 Removal

Removal refers to the physical process of taking contaminated material out of its current location. For Facility soils, removal is also referred to as excavation.

For Hudson Branch, removal is also referred to as excavation. Sometimes removal in waterways is called dredging. The Army Corps of Engineers (ACOE) indicates that stream excavation may include or be based on some combination of the following (ACOE 2008):

- "Removal of all sediment having contaminant concentrations above a specific action level) and
- Removal of sediments to a specified elevation within specified areas."

For the Hudson Branch, removal will require disturbing some of the associated wetlands habitat. In evaluating removal, proper consideration needs to be given to the ramifications of disturbing the habitat versus the environmental benefit. Mature wetlands have significant ecological benefits. The extents of removal decision should balance the advantages of permanent removal and preservation of habitat on a "net benefit" basis, as discussed below in section 3.4.4.

4.1.6 Treatment

Treatment consists of various processes that can change the physical, biological or chemical nature of soil or sediments. For example, sediment from the Hudson Branch could be treated to either reduce its moisture content (e.g. to make it more readily transportable) and/or to reduce its leaching characteristic (e.g. render its leachate to be characteristically non-hazardous, if applicable). Treatment can typically be performed "in situ" or "ex situ" depending on project needs. Ex-situ treatment include the application of an appropriate treatment technology after the material has been excavated. In Situ treatment means that the treatment technology is applied "in place".

4.1.6.1 Soil Washing and Chemical Extraction

Soil washing involves treatment of excavated soils or fill with a wash or extracting fluid. Ex-situ processes typically incorporate agitation to improve contact between soil/fill and the extracting fluid. Large objects and debris are screened from the excavated soil/fill, with remaining soil particles transported to the soil washer. The contaminated soil is vigorously mixed with the wash fluid. Water is a common soil washing fluid, but may include chemical additives such as acids, bases, chelants, or complexing agents for removal of heavy metals (chemical extraction). Treatment of wash fluids by enhanced clarification to remove fines and/or additional treatment to remove or stabilize solubilized contaminants may be required prior to discharge/disposal. Washed soil/fill may also require mechanical dewatering to remove excess water and wash fluids.

4.1.6.2 Solidification/Stabilization (S/S)

Solidification/stabilization (S/S) fixates inorganic compounds by introducing stabilizing agents into the excavated soil/sediment. The stabilizing agents react with heavy metal cations. The solidifying agents bind and encapsulate the precipitated cations, substantially reducing the potential for leaching. Ex-situ S/S typically involves excavation and mixing of S/S reagents in a pug mill. The S/S product may be formed in a cubic mold or poured into the excavation to cure into a stable, monolithic solid matrix. A granular, compactable product can also be produced, depending on the reagents and curing process.

4.1.6.3 Drying

Typically, material hauled to offsite disposal facilities must be suitably dry (*i.e.* to pass the paint filter test). Drying may include air drying, blending with dryer material, or adding drying agents.

4.1.7 Disposal

Material must be suitably disposed after material excavation/removal (discussed in Section 4.2.5). Sometimes, consideration is given to disposing the materials onsite (e.g. under a cap) or offsite, at a suitably permitted facility. The nature of the material has to be considered as part of the material disposal considerations.

4.2 Facility Soils

As stated in Section 2, significant remediation of Facility Soils has occurred, including the excavation/removal of lagoon soils, the installation of a vegetated cap, and the maintenance of existing buildings/paving as caps. Facility soil remedial alternatives address proposed/future actions. The additional alternatives for the Facility soils include:

- Facility Soils Alternative #1- No Action
- Facility Soils Alternative #2- Limited Additional Action
- Facility Soils Alternative #3- Additional Capping
- Facility Soils Alternative #4- Targeted Excavation
- Facility Soils Alternative #5- Ex-Situ Treatment

Each of these alternatives is described in the subsections below.

Facility Soil Alternatives #2, #3, and #4 incorporate and builds upon the existing fencing, covers, caps, and the previous cleanup of the lagoons to complete the response actions at the Site. In Facility Soil Alternatives #2, #3, and #4, the small areas to the north of the northern fence that exceed ecological PRGs will be addressed via monitoring as these areas have existing vegetative cover.

Another common component of Facility Soil Alternatives #2, #3, and #4 is a deed notice.

A proposed deed notice would be implemented, which would include:

- Protecting site workers by requiring appropriate measures be taken during site operations (such as subsurface utility work);
- Preserving existing caps/covers and fencing; and
- Maintaining the future property use as industrial.

The deed notice is also a method to inform potential future owners of site conditions.

For any Superfund site that does not immediately achieve residential standards, EPA requires 5-year project reviews. Because potential remedial alternatives are not expected to achieve residential standards, each of the Facility Soil alternatives includes a 5-year review cycle.

The Facility Soil Remedial Alternatives are conceptually depicted in Figure 4.

4.2.1 Facility Soils Alternative #1- No Action

The "no action" alternative serves as the baseline for comparison with other alternatives and is required by the National Contingency Plan (NCP) and by CERCLA/Superfund guidance. In this alternative, no *additional* remedial action is taken beyond actions already taken so pre-existing fencing and existing caps/covers would remain but areas not yet addressed (*i.e.* the uncapped area in the Eastern Storage Areas) would remain without additional treatment, control or monitoring in this alternative. No action would include no institutional controls. Without institutional controls, permanence of pre-existing fencing and existing caps/covers would not be ensured.

4.2.2 Facility Soils Alternative #2- Limited Additional Action

In the Facility Soil Alternative #2- Limited Additional Action, additional fencing would be installed around the targeted portion of the Facility, namely, the uncapped portion of the Eastern Storage Area.

There is currently existing fencing and caps/covers over most of Facility Soils. The existing nature and continuity of caps and covers will be maintained as they were originally constructed. A proposed deed notice would be implemented.

4.2.3 Facility Soils Alternative #3- Additional Capping

Facility Soils Alternative #3-Additional Capping includes the construction of a cap over the uncapped portion of the Eastern Storage Areas to prevent direct contact with identified impacts. It is anticipated to install a gravel cap over the 1.3 acres that is currently not covered. This type of cap is consistent with the Site use, but would prevent direct contact. The total present value project costs for this Alternative are $960,000.

The pre-existing engineering controls of fencing and caps/covers would be maintained. Similar to Alternative #2, a proposed deed notice would also be implemented.

4.2.4 Facility Soils Alternative #4- Targeted Excavation

Facility Soils Alternative #4- Targeted Additional Excavation and Off-Site Disposal, includes the excavation and offsite disposal of soils from the uncapped portion of the Eastern Storage Areas with suitable backfill and restoration. Approximately 21,000 yds^3 would be excavated. It is anticipated that the contaminated soil will be trucked off-Site and managed as non-hazardous. The total present value project costs for this Alternative are $7,260,000.

The existing engineering controls of fencing and existing caps/covers would be maintained.

Similar to Alternatives #2 and #3, a proposed deed notice would be implemented.

4.2.5 Facility Soils Alternative #5- Ex-Situ Treatment

Facility Soils Alternative #5- Ex-Situ Treatment includes excavation of on-Site soils that exceed PRGs. Soil washing or stabilization/solidification could be utilized to remove or stabilize the contaminants in the soil.

Screening and Evaluation of Remedial Technologies and Process Options for Facility Soil							
General Response Actions	**Remedial Technology**	**Process Option**	**Description**	**Implementability**	**Effectiveness**	**Cost**	**Retained or not Retained for further Consideration**
Engineering Control, Limited Action	Access Restrictions	Fencing, Deed Notice	Existing fencing and deed notice to restrict access	Easily implementable since fencing is already installed	Restricts human access, but does not address ecological risk	No capital cost, Low O&M cost	Retained
Containment	Capping	Vegetated/ asphalt/ gravel cover	Use of a cover consisting of top soil with vegetation, asphalt, or gravel to minimize erosion and contact with impacted surface soil. Top restoration cover selected based upon site use and restoration requirements within the covered area. Grading and cover installation would be performed such that drainage is promoted, erosion is minimized, and cover integrity is protected. The cover is required to be one foot thick for sites with industrial usage and suitable to sustain vegetative growth.	Easy to implement for on-Site soils.	Effective means of minimizing direct contact with exposed soil, and infiltration of surface water.	Low capital Low O&M	Retained
Disposal	Off-site disposal	Commercial Landfill	Most contaminated soil would be disposed in a non-hazardous waste landfill. Any excavated soil that is characterized as containing hazardous waste would be treated and/or disposed at an appropriate facility.	Easily Implementable for most soil which does not contain hazardous waste	Effective for soil and treatment residuals suitable for land disposal.	High capital No O&M	Retained
Treatment	Ex-Situ Treatment	Soil Washing, Solidification, Stabilization	Treatment of contaminated soil and sediment to remove or stabilize contaminants.	Difficult to implement. Requires areas to stage and treat	Effective for removal or stabilization	High capital expense. Probably no O&M	Not Retained

R2-0003332

4.3 Hudson Branch

The range of remedial alternatives for the Hudson Branch includes:

- Hudson Branch Alternative #1- No Action
- Hudson Branch Alternative #2- Limited Action
- Hudson Branch Alternative #3- Complete Excavation
- Hudson Branch Alternative #4- Excavation/Capping
- Hudson Branch Alternative #5- Capping

Each remedial alternative is described in the subsections below. The Hudson Branch alternatives retained for detailed analysis are conceptually depicted in Figure 5.

Common Components

A common component of Hudson Branch Alternatives #2, #4, and #5 is stream monitoring, which would be performed after active remediation to gauge the long term effect of the sediment remediation conditions. The other common theme with Hudson Branch Alternatives #2, #3, #4, and #5 is that they are designed to address the identified risk, which is exposure to targeted ecological receptor populations. Each alternative includes some form (or a combination of forms) to reduce/eliminate exposure pathways, either via removal and/or capping.

4.3.1 Hudson Branch Alternative #1- No Action

The "no action" alternative serves as the baseline for comparison with other alternatives as required by the NCP and CERCLA/Superfund guidance. In this alternative, no action is taken so impacts remain without any treatment, control or monitoring.

4.3.2 Hudson Branch Alternative #2- Limited Action

This remedial alternative includes the installation of fencing and the performance of stream monitoring/MNR. Fencing would be installed around impacted areas to limit access. The remedial design would develop a detailed monitoring plan. For purposes of this FS, monitoring includes regular inspections with basic sediment and/or plant sampling. Plant monitoring is necessary due to potential plant impacts from manganese, nickel and vanadium.

4.3.3 Hudson Branch Alternative #3-Complete Excavation

This Alternative primarily includes the excavation of all Hudson Branch sediments that exceed the PRGs. Excavation would generally entail physical removal of sediments using conventional earth moving equipment.

A total of 9,600 yds^3 of contaminated sediments would be disposed offsite after it was suitably treated. Based on geotechnical testing performed during FS development, some treatment may be required so that the material is dry enough to be transported (*i.e.* to pass the paint filter test). For purposes of FS planning and cost estimating, drying may include air drying, blending with dryer material, or adding drying agents. Based on screening completed during FS development, no Hudson Branch sediment exhibited hazardous characteristics. For purposes of FS planning and cost estimating, a certain percentage of excavated material will be assumed to require treatment to render it characteristically non-hazardous.

Multiple wetland habitats exist adjacent to the Hudson Branch, including the following palustrine wetland types: emergent marsh, broad-leaved deciduous forest, scrub-shrub, and open water. The width of the wetlands ranges from approximately 5 feet (along the generally dryer reach of Hudson Branch along the Facility boundary) to over 400 feet (near the southwest corner of the Facility). At a number of points along Hudson Branch, the wetland vegetation consists of monostands of vegetation that provides lesser quality habitat (i.e. monostands of phragmites). Wetlands vegetation (outside of the phragmites) includes combinations of overstory (red maple, pin oak, sweet gum, black willow, green ash, and white ash) with an understory (dominated by ferns).Excavated areas would be backfilled to appropriate lines and levels, to match surrounding grades. For purposes of FS planning and cost estimating, it is assumed that clean fill will be used as a backfill base, as needed, and that excavated areas will be completed with a layer of topsoil. Restoration is assumed to include the application of seed appropriate to the setting (to foster revegetation), and installation of erosion mats, as appropriate. This alternative will include the installation of woody plants for scrub-shrub and forested wetlands. A total of less than 5 acres, which will include emergent, scrub-shrub, and forested wetlands will be restored. Additionally, a wetlands assessment and restoration plan will be provided for any wetlands impacted or disturbed by the remedial activities. The total present value project cost of this Alternative is $6,040,000.

4.3.4 Hudson Branch Alternative #4- Excavation/Capping

This alternative includes excavation of 8,500 yds^3 of sediments within the channel to the depth of PRG exceedance, and the focused excavation/capping of overbank wetland/floodplain sediment exceeding PRGs. The focused excavation would entail the removal of a sufficient depth of sediment to allow cap installation. The excavation is necessary to ensure that floodplain areas are not filled by the capping in this remedial alternative.

Based on currently available information, a significant portion of the overbank area subject to proposed excavation in the vicinity of the Facility's southern boundary will encompass primarily wetlands that currently have lower quality habitat (phragmites). Similarly, areas subject to proposed excavation near the Car Wash and downgradient of the Car Wash will include some areas with lower quality habitat (phragmites). Some areas subject to excavation may include areas with higher quality habitat (*e.g.* larger specimen trees). Higher quality vegetation, where it exists, generally exists in the overbank areas (*i.e.* outside of the stream's primary channel). Capping within the Hudson Branch primary channel may not be appropriate because it would clog the channel and create drainage problems (and violate the "no net fill" principle). The primary channel will be excavated, as discussed above.

Capping in overbank (not in the Hudson Branch channel) is included. Because the remedies target protection of ecological concerns, the cap thickness should be suitable to protect target flora/fauna. Because the targeted populations include species that occupy shallow areas, the depth of capping (and associated excavation to allow the capping) is six (6) inches. This layer would consist of topsoil and restoration. This kind of capping would work around large trees, and therefore help preserve natural ecology. The remedial design can identify these areas and further balance the net-benefit of proposed capping. The FS included some basic visual reconnaissance to approximate areas that would benefit from capping in the Hudson Branch. The total present value project costs will be $4,490,000.

During remedial design and/or construction, additional data may indicate that some material that exceeds PRGs exists in isolated location(s) and/or locations of particularly sensitive areas. In these areas, monitoring (or MNR) could be applicable, and is included, conceptually, in this overall alternative.

The remedial design will advance all of these assumptions, based on additional data and/or analysis.

4.3.5 Hudson Branch Alternative #5- Capping

This alternative includes capping (only) of impacted areas. Similar to Alternative #4, the capping would consist of the installation of a layer of topsoil, followed by revegetation. Unlike Alternative #4, no excavation is included in Alternative #5.

4.3.6 Hudson Branch Alternative #6- Treatment

This Alternative includes excavation of on-Site soils that exceed PRGs. Soil washing or stabilization/solidification could be utilized to remove or stabilize the contaminants in the soil so that they can no longer potentially leach to groundwater.

Screening and Evaluation of Remedial Technologies and Process Options for Hudson Branch							
General Response Actions	**Remedial Technology**	**Process Option**	**Description**	**Implement ability**	**Effectiveness**	**Cost**	**Retained or not Retained for further Consideratio n**
Engineering, Institutional Controls,	Fencing	Fencing, Monitored Natural Recovery (MNA)	Installation of fencing surrounding areas of contamination that presents human health concerns. Long term monitoring to assess improvement due to natural processes	Difficult to implement on properties not owned by Shieldalloy. MNA requires long term monitoring.	Effective means of restricting human contact. Effectiveness of MNA is not easily predictable .	Medium capital cost Low O&M cost	Retained
Disposal	Off-site disposal	Commercial Landfill	Most contaminated soil would be disposed in a non-hazardous waste landfill. Any excavated soil that is characterized as containing hazardous waste would be treated and/or disposed at an appropriate facility.	Implementable for excavated soil that meets land disposal restrictions.	Effective for contaminated sediments.	High capital No O&M	Retained;
Disposal and Containment	Excavation and Capping	Targeted excavation and capping	Permanently removing metal to achieve ecological net benefit and cap other areas	Moderately difficult to implement. Requires targeted excavation and placement of cap	Effective in eliminating exposure pathways	Moderate capital and O&M costs	Retained
Containment	Capping	Install a layer of top soil on sediment	Use of a cover consisting of top soil with vegetation, asphalt, or gravel to minimize erosion and contact with impacted surface soil. Top restoration cover selected based upon site use and restoration requirements within the covered area. Grading and cover installation would be performed such that erosion is minimized, and cover integiity is protected.	Cannot implement and maintain on properties not owned by Shieldalloy but easy to implement for on-Site soils.	Effective means of minimizing erosion of, and direct contact with exposed soil, and infiltration of surface water.	Low capital Low O&M	Not retained .
Treatment	Ex-Situ Treatment	Soil Washing, Chemical Extraction Solidificatio n, Stabilizatio n	Treatment of contaminated soil and sediment to remove or stabilize contaminants.	Difficult to implement. Requires areas to stage and treat	Effectiveness is a function of the treatment method. Residues of treatment can probably be put back	High capital expense. O&M is dependen t on disposal method	Not Retained

R2-0003337

5 DEVELOPMENT AND SCREENING OF ALTERNATIVES

The remedial alternatives for the Facility soils and Hudson Branch are developed and screened in the subsections below.

5.1 Facility Soils

5.1.1 Facility Soils Alternative # 1- No Action

The "no action" Alternative serves as the baseline for comparison with other Alternatives. Since no action is taken, impacts remain without any treatment, control or monitoring.

Facility soils Alternative # 1 – No Action does not achieve the RAOs. However, this alternative is retained in accordance with Superfund requirements.

5.1.2 Facility Soil Alternative #2- Limited Additional Action

Facility Soil Alternative #2 - Limited Additional Action continues to prevent trespasser human health exposure via the existing fencing and protect workers via a deed notice.

This alternative provides many advantages, but may not sufficiently protect the uncapped area of the Eastern Storage Area from ecological receptors, so it marginally satisfies the RAOs relative to human exposures. The Facility Soil Alternative #2 – Limited Additional Action is retained to provide a suitable array of options for detailed analysis of RAOs.

5.1.3 Facility Soil Alternative #3- Additional Capping

Facility Soil Alternative #3-Additional Capping (including maintaining existing fencing and caps/covers, and implementing a deed notice) better satisfies the RAOs than Alternative #2 – Limited Action. In fact, Alternative #3 is superior to #2 because #3 provides the additional capping which is more protective than additional fencing alone.

Therefore, Facility Soil Alternative #3 – Additional Capping satisfies the RAOs and is retained.

5.1.4 Facility Soil Alternative # 4- Targeted Excavation

Facility Soil Alternative #4- Targeted Excavation (including maintaining existing fencing and caps/covers, and implementing a deed notice) would satisfy the RAOs. This alternative would permanently remove some contamination to an off-site disposal facility.

This alternative has the greatest cost. Further, this alternative requires transporting several hundred trucks of material via public roads to an appropriate disposal facility. This trucking can be inconvenient to the public.

Although Facility Soil Remedial Alternative #4 has much higher costs and greater implementability challenges, it is still retained.

5.1.5 Facility Soil Alternative #5- Treatment

Facility Soil Alternative #5- Treatment of on-Site contaminated soil would involve excavation of soil from the 1.3 acre Eastern Storage Area that exceeds PRGs, constructing a treatment area on-Site, treating the contaminated soil and returning it to the Site. This Alternative would permanently remove the contaminants from the soil, but it would be very expensive. If soil washing was implemented, it would require the disposal of contaminated water. If the soil was stabilized, it would result in a greater volume of soil to be returned to the Site. This alternative is not retained.

5.2 Hudson Branch

The remedial alternatives for Hudson Branch are screened in the subsections below.

5.2.1 Hudson Branch Alternative #1- No Action

The “no action” alternative serves as the baseline for comparison with other alternatives. In this alternative, no action is taken so impacts remain without any treatment, control or monitoring. Alternative #1 would require that 5-year reviews would be conducted to evaluate the need for future remedial actions. Alternative #1 does not achieve the RAOs..

Alternative Hudson Branch #1 – No Action does not achieve the RAOs, but is retained in accordance with Superfund requirements.

5.2.2 Hudson Branch Alternative #2- Limited Action

Hudson Branch Remedial Alternative #2 - Limited Action (including fencing and monitoring/MNR) is a remedial approach that is accepted at many sediment sites because it can achieve a net benefit (*e.g.* preserving habitat while addressing exposure over time). However, Limited Action cannot achieve the RAO of mass reduction of metals in a timeframe that is consistent with project objectives. Components such as monitoring may be more appropriate for areas of higher quality habitat with lower metal mass, but is not suitably applied as a stand-alone alternative over the entire body of Hudson Branch.

Hudson Branch Alternative #2 – Limited Action does not satisfy the RAOs as a stand-alone alternative; however, it is retained to provide a suitable array of alternatives for detailed evaluation.

5.2.3 Hudson Branch Alternative #3—Complete Excavation

Hudson Branch Alternative #3 Complete Excavation would remove all material above PRGs from Hudson Branch. This alternative would include the destruction of higher value vegetation/habitat in order to facilitate the excavation. This alternative would satisfy RAOs (though would do so with lesser ecological net benefit).

Hudson Branch Alternative #3 Complete Excavation is retained.

5.2.4 Hudson Branch Alternative #4- Excavation/Capping

Hudson Branch Alternative #4 – Excavation/Capping (with targeted monitoring) includes excavating the targeted areas of Hudson Branch to the appropriate PRGs, treating (as appropriate), disposing the material at a permitted facility, restoring excavated areas, applying capping at appropriate locations, and focused monitoring.

Hudson Branch Alternative #4 satisfies the RAOs by permanently removing metal mass from Hudson Branch and achieves an ecological net-benefit by restoring disturbed areas and minimizing the destruction of higher quality habitat via capping and MNR. This alternative is retained for more detailed evaluation.

5.2.5 Hudson Branch Alternative #5- Capping

Hudson Branch Alternative #5 Capping includes placing a layer of topsoil over Hudson Branch areas exceeding PRGs. This alternative accomplishes RAOs to a degree, but, the operation of placing fill in a floodplain, without compensating excavations (as provided in Alternative #4) is improper, and not in accordance with Flood Hazard programs.

Accordingly, Hudson Branch Alternative #5 Capping is not retained.

5.2.6 Hudson Branch Alternative #6- Treatment

Hudson Branch Alternative #6- Ex-Situ Treatment include soil washing, chemical extraction or stabilization/solidification. These options are technically possible. However, they all require a treatment area, which would be difficult to locate off-Site. Treatment would be expensive and would disrupt the community. Stabilization would result in a larger volume of soil to replace or dispose of off-Site. This alternative is not retained.

6. DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

The Detailed Analysis of Remedial Alternatives was conducted in accordance with Superfund requirements, in order to provide the synthesis of information needed to select the Site remedy. The evaluation process and comparative analysis of Alternatives are described in the following sections and in referenced figures, tables and appendix.

6.1 Evaluation Process

The remedial alternative evaluation process is primarily based on EPA's nine criteria. Because Green Remediation is now a fundamental part of EPA's work and should be a part of Superfund cleanups, Green Remediation principles are also discussed.

6.1.1 Superfund Evaluation Criteria

In order to conduct a comprehensive, detailed analysis of the Remedial Alternatives, the *RI/FS Guidance* requires that each of the proposed remedial alternatives be assessed against the evaluation criteria that have been developed to address the statutory considerations listed under CERCLA. The nine criteria used to assess the remedial alternatives are listed below, including a brief description of each.

Threshold Criteria

1. Overall protection of human health and the environment;
    - reducing toxicity and/or potential exposure and meeting identified RAOs
2. Compliance with ARARs;
    - Meeting federal/state ARARs (or justifying waivers thereto). As noted in Section 3.4, location-specific and action specific ARARs are not currently applicable to the site.

Balancing Criteria

3. Long-term effectiveness and permanence;
    - Scale of the residual risk and adequacy and reliability of controls
4. Reduction in toxicity, mobility;
    - The degree to which volume of material destroyed or treated, the degree of expected exposures, the degree to which treatment is irreversible and the type and quantity of residuals remaining
5. Short-term effectiveness;

- Impacts and risk associated with alternative implementation, considering protection of the community and workers and the expected effects on the environment. The criterion also evaluates the effectiveness of mitigative measures and time until the final protection is achieved

6. Implementability;

   - Both technical and administrative feasibility, including the ability to construct the various components and systems, the reliability of the components and systems and the ability to effectively monitor the alternative**.**

7. Cost;

   - Capital costs, operation and maintenance, and present worth.

Modifying Criteria (considered further after public comment period)

8. State acceptance; and
9. Community acceptance.

The first two criteria are considered threshold criteria, and relate to the statutory requirements that the alternative should satisfy. The next five criteria are considered balancing criteria, which are technical in nature and are used as the primary basis for evaluation. The final two are considered modifying criteria, and are assembled formally after the public comment period. Therefore, the last two criteria are not used in this Revised Draft FS evaluation.

The Cost criterion warrants additional discussion because regulation and EPA practice and guidance devotes specific references to this topic. The National Contingency Plan (NCP) dictates in 40 CFR 300.430(f)(1)(ii)(D) that remedial costs should be "proportional to its overall effectiveness." In fact, the preamble to the NCP states that if "remedies examined are equally feasible, reliable, and provide the same level of protection, the agency will select the least expensive remedy" [underlining added]. The NCP notes in 40 CFR 300.430(e)(7)(iii) that alternatives may be screened out if costs are grossly excessive compared to their overall effectiveness. EPA's *Guidance to Conducting RI/FS Under Superfund*[c] precludes the selection of a higher cost remedial alternative where there is no proportional value. Historically, Superfund practice has been that if one remedial alternative costs 50% or more than another remedial alternative (which compare similarly in other aspects), then the lower cost alternative should be selected, although this numeric criterion is no longer applied. EPA's *Role of Cost in the Superfund Remedy Selection Process* indicates that "cost is a central factor in all Superfund selection decisions."

6.1.2 Green Remediation Principles

The EPA is fostering "Green Remediation" principles for Site cleanups. Although not specifically required in feasibility studies by statute, the incorporation of Green Remediation principles provides a sound basis for remedial alternative analysis, and promotes sustainable Site management ideals. Specifically, EPA has issued a Green Remediation Strategy encouraging, where possible, the incorporation of options into remedies that minimize the environmental footprint of cleanup actions.

EPA, particularly Region 2, advocates the implementation of Green Remediation principles. The Revised Draft FS includes an evaluation of each Alternative relative to Green Remediation. The EPA outlines key Green Remediation principles in EPA's Superfund Green Remediation Strategy, as follows:

1. Minimize Total Energy Use
2. Minimize Air Pollutants and Greenhouse Gas Emissions
    - Minimize the generation of greenhouse gases
    - Minimize generation and transport of airborne contaminants and dust
    - Sequester carbon on-Site (*e.g.*, soil amendments, re-vegetate)
3. Minimize Water Use and Impacts to Water Resources
    - Minimize water demand for re-vegetation (*e.g.* native species)
    - Employ best management practices for stormwater
4. Reduce, Reuse and Recycle Material and Waste
    - Minimize consumption of virgin materials
    - Minimize waste generation
    - Use recycled products and local materials
    - Beneficially reuse waste materials
    - Segregate and reuse or recycle materials, products, and infrastructure (*e.g.* soil)
5. Protect Land and Ecosystems, including
    - Minimize areas requiring activity or use limitations (*e.g.*, destroy or remove contaminant sources) and
    - Minimize unnecessary soil and habitat disturbance or destruction

To address Green Remediation Principles, each proposed Alternative was evaluated on this basis as well.

6.2 Individual Analysis of Remedial Alternatives

The individual analyses of the alternatives are summarized in Tables 1 and 2, and are described in the following sections. The summary of conceptual cost estimates for the Hudson Branch and Facility Soil remedial alternatives is provided in Table 3. The conceptual cost estimates for each Facility Soils and Hudson Branch remedial alternative are presented in Tables 4 and 5, respectively. The Remedial Alternatives for the Facility Soil and Hudson Branch are depicted in Figures 4 and 5, respectively.

6.2.1 Facility Soils

6.2.1.1 Facility Soils Alternative #1– No Action

The no-action alternative is defined as taking no further action to address the soils in the Eastern Storage Area that exceed PRGs. The no-action alternative provides a baseline for comparing other remedial alternatives.

***Overall Protection of Human Health and the Environment* -** The no-action alternative would not address the Remedial Action Objectives for preventing direct exposure to contaminated soil. This alternative would not address the Remedial Action Objective for mitigating excess risk due to contaminated soil at the Site. Therefore, the no-action alternative would not be protective of human health and the environment.

***Compliance with ARARs* -** *Chemical-Specific ARARs:* The no-action alternative does not meet chemical-specific ARARs because it does not address the soil contamination that exceeds ARAR.

***Long-Term Effectiveness and Permanence* -** This alternative provides no long-term effectiveness or permanence. Current and future risks would remain under this alternative.

***Reduction of Toxicity, Mobility, or Volume Through Treatment* -** This alternative provides no reduction in toxicity, mobility, or volume of constituents in the Eastern Storage Area.

***Short-Term Effectiveness* -** There would be no additional short term risks posed to the community, Site workers, or the environment associated with implementation of this alternative.

***Implementability* -** No technical or action-specific administrative implementability issues are associated with this alternative.

***Cost* -** No capital costs are associated with the no-action alternative.

6.2.1.2 Facility Soil Alternative # 2– Limited Additional Action

Institutional controls would involve fencing the 1.3 acre area of the Eastern Storage Area that is not already covered. A deed restriction would be placed on this portion of the Site to limit future use (e.g., to prevent subsurface construction in this area). If subsurface construction is anticipated, a management plan may be developed to provide guidance for workers involved in handling of soil/fill from this area (e.g., personal protective equipment requirements during underground utilities construction, methods for disposing of soil/fill removed from excavations, etc.).

Limited Additional Action protects the ecology in areas already capped. But does not protect the ecology in the uncapped portion of the Eastern Storage Area. Accordingly, Alternative #2 ranks favorably for overall protectiveness of the environment, long term effectiveness and reduction to toxicity/mobility. This alternative has a low cost. This alternative is not considered very “green” because it does not suitably protect the ecological receptors.

Overall Protection of Human Health and the Environment – Based on the results of the BHHRA and SLERA, human health and ecological PRGs were established. Additional fencing and a deed notice can address the human health PRGs by restricting access. However, this remedy would not be effective in addressing the ecological risk.

***Compliance with ARARs* -** The chemical-specific ARARs would not be net by this alternative because it does not address ecological risk.

Long-Term Effectiveness and Permanence - Installation of fencing and the deed notice would prevent direct contact with the contaminated soil by human receptors only. It would not be effective for ecological receptors.

***Reduction of Toxicity, Mobility, or Volume Through Treatment* -** The Limited Additional Action alternative would not reduce the toxicity, mobility, or volume of constituents in the Eastern Storage Area.

***Short-Term Effectiveness* -** There would be no substantial risks posed to the community, Site workers, or the environment associated with implementation of this alternative. The alternative would become somewhat effective once the fencing has been erected and the deed restrictions have been obtained

***Implementability* -** No technical implementability issues are associated with this alternative. Implementability issues may include administrative delays in placing deed restrictions.

***Cost* -** The estimated capital cost for this alternative is $168,000. Annual OM&M costs for fence and cover system maintenance are estimated to be $709,000 resulting in an estimated 30-year present worth cost of $880,000.

6.2.1.3 Facility Soil Alternative # 3- Additional Capping

Additional Capping includes the construction of a cap over the uncapped portion of the Eastern Storage Area to prevent direct contact with identified impacts. Groundwater contamination is not being addressed in OU2 and therefore, the goal of this remedy is prevent direct contact. It is anticipated to install a gravel cap over the 1.3 acres that is currently not covered. This type of cap would prevent direct contact and would result in infiltration of stormwater which would preclude the need for stormwater management.

Additional Capping (including maintaining existing fencing and caps/covers, and a deed notice) ranks the highest against all of the evaluation criteria except cost. Because the existing fencing and caps/covers are maintained, as ensured via the deed notice, and because the uncapped area is addressed (via a cap), this alternative is protective of human health and the environment, is compliant with ARARs, is long term effective and permanent, reduces mobility, is short term effective, and is implementable. Alternative #3 is more expensive than #1 or #2, though less expensive than #4. This alternative is considered very "green" because it suitably protects ecological receptors, while maintaining a controlled environmental footprint during and after remediation.

***Overall Protection of Human Health and the Environment* -** This alternative addresses the RAOs by preventing direct exposure to human and ecological receptors to Facility Soil, including in the Eastern Storage Area.

***Compliance with ARARs* -** Capping the remaining area of the Eastern Storage Area would comply with chemical specific ARARs by eliminating the potential for human and ecological exposure.

***Long-Term Effectiveness and Permanence* –** Once the remaining area of the Eastern Storage Area is capped, the cap will be inspected and maintained, as necessary. Therefore, this proposed remedy can be considered an effective and permanent remedy for the achievement of applicable PRGs.

***Reduction of Toxicity, Mobility, or Volume Through Treatment* -** This alternative does not involve treatment and therefore, there is no reduction of toxicity, mobility or volume.

***Short-Term Effectiveness* -** Site workers would likely be required to wear personal protective equipment (PPE) during placement of the cover to prevent direct contact with contaminated soil. Dust control methods would be used to limit the release of particulates during placement of the soil cover. No significant risks to the community or the environment are anticipated under this alternative. Some minor disruption of the neighboring area may occur due to soil deliveries and noise from heavy equipment used to construct the remedy. Some wildlife disruption may occur due to disturbance of the Site during construction. The Remedial Action Objectives would be achieved once the cover was established.

Implementability **-** No significant technical implementability issues are associated with this alternative. No action-specific administrative implementability issues are associated with this alternative.

Cost **-** The estimated capital cost for this alternative is $280,000. Annual OM&M costs for inspection and repair of the cap are estimated to be $680,000, resulting in an estimated 30-year present worth cost of $960,000.

6.2.1.4 Facility Soil Alternative # 4- Targeted Excavation

Facility Soil Alternative #4- Targeted Excavation supplements previous excavation/disposal work with excavation/disposal from the uncapped area of the Eastern Storage Areas. Because the existing fencing and caps/covers are maintained, as ensured via the deed notice, and because the uncapped area is addressed (via excavation/disposal), this alternative is protective of human health and the environment, is compliant with ARARs, is long term effective and permanent, reduces mobility, and is implementable. Because the trucking required to dispose of the excavated material will travel through the local roads, the community will have potential impact via traffic and noise. Accordingly, this alternative ranks the poorest for short term effectiveness. Also, this Alternative ranks the poorest for cost, due to its significant capital cost. Weighing the capital cost against minimal benefits, as required by Superfund, indicates that this alternative is inconsistent with Superfund evaluation procedure. This alternative is also the least “green” because its environmental footprint is very large compared to the results obtained.

Overall Protection of Human Health and the Environment **-** This alternative satisfies the RAOs for preventing direct exposure to the contaminated soil through excavation and off-site disposal. Existing caps will be inspected and maintained, as necessary. Accordingly, this alternative would be protective of human health and the environment.

Compliance with ARARs **-** Excavation and off-site disposal would achieve the chemical-specific ARARs by eliminating the soil that exceeds human health and ecological PRGs.

Long-Term Effectiveness and Permanence **–** Excavation and disposal of remaining exposed soil that exceeds PRGs would be permanently effective.

Reduction of Toxicity, Mobility, or Volume Through Treatment **-** This alternative does not reduces the toxicity, mobility or volume of the contaminated soil.

***Short-Term Effectiveness* -** Site workers would likely be required to wear personal protective equipment (PPE) during excavation and transport of the contaminated soil. Dust control methods would be used to limit the release of particulates during excavation. Some disruption of the neighboring area may occur due to trucks entering and leaving the Site and noise from heavy equipment used to excavate and move the soil. Some wildlife disruption may occur due to disturbance of the Site during construction. The Remedial Action Objectives would be achieved once the contaminated soil is excavated and removed from the Site.

***Implementability* –** 21,000 yds^3 of sediments would need to leave the Site. Dust, erosion and odor controls would be required. Administrative implementability issues may be encountered in securing approval for disposal of the material at an off-site facility.

***Cost* -** The estimated capital cost for this alternative is $6,573,000. Annual OM&M costs for maintenance of existing fences and caps are estimated to be $686,000, resulting in an estimated 30-year present worth cost of $7,260,000.

6.2.2 Hudson Branch

6.2.1.1 Hudson Branch Alternative #1-No Action

Hudson Branch Alternative #1 has been retained in the analysis per Superfund procedures. This alternative ranks poorly for all criteria except cost and implementability. This alternative does not eliminate any exposure pathway. This alternative is not considered "green" because it is not protective of the ecology. This alternative provides a baseline comparison for other alternatives.

***Overall Protection of Human Health and the Environment* -** The no-action alternative would not address the Remedial Action Objectives for preventing direct exposure to contaminated soil. This alternative would not address the Remedial Action Objective for mitigating excess risk due to contaminated sediments in the Hudson Branch. Therefore, the no-action alternative would not be protective of human health and the environment.

***Compliance with ARARs* -** The no-action alternative does not meet chemical-specific ARARs because it does not address the sediment contamination that exceeds PRGs.

***Long-Term Effectiveness and Permanence* -** This alternative provides no long-term effectiveness or permanence. Current and future risks would remain under this alternative.

***Reduction of Toxicity, Mobility, or Volume Through Treatment* -** This alternative provides no reduction in toxicity, mobility, or volume of hazardous constituents in the sediments of the Hudson Branch.

***Short-Term Effectiveness* -** There would be no additional short term risks posed to the community, Site workers, or the environment associated with implementation of this alternative.

***Implementability* -** No technical or action-specific administrative implementability issues are associated with this alternative.

***Cost* -** No capital costs are associated with the no-action alternative.

6.2.1.2 Hudson Branch Alternatives #2- Limited Action

This remedial alternative includes the installation of fencing and the performance of stream monitoring/MNR. Fencing would be installed around impacted areas to limit access. The remedial design would develop a detailed monitoring plan. Monitoring includes regular inspections with basic sediment and/or plant sampling.

This alternative would not achieve the RAOs because the proposed fencing would not sufficiently protect the ecological receptors. Hudson Branch Alternative #2 is not protective of human health and the environment, is somewhat compliant with ARARs, is not long term effective and permanent, does not reduces mobility. Alternative #2 ranks favorably with short term effectiveness, implementable and is low cost. This alternative is not considered "green" because it is not protective of the ecology.

***Overall Protection of Human Health and the Environment* –** Based on the results of the SLERA, ecological PRGs were established. Additional fencing would not be effective in addressing the ecological risk. Long term monitoring through an MNR program may result in reduction in exposure to ecological receptors through reduced toxicity and/or mobility due to natural processes.

***Compliance with ARARs* -** The chemical-specific ARARs would not be met by through the installation of fencing because this alternative does not address ecological risk. Long term monitoring through an MNR program may demonstrate reductions in toxicity and/or mobility.

***Long-Term Effectiveness and Permanence* -** Installation of fencing would prevent direct contact with the contaminated soil by human receptors only, but it would not be effective for ecological receptors that are impacted by the contaminated sediments. MNR may result in future permanent reductions in toxicity and/or exposure.

***Reduction of Toxicity, Mobility, or Volume Through Treatment* -** The Limited Additional Action alternative would not reduce the toxicity, mobility, or volume of constituents in the sediments of the Hudson Branch.

***Short-Term Effectiveness* -** There would be no substantial risks posed to the community, Site workers, or the environment associated with implementation of this alternative.

***Implementability* -** No technical implementability issues are associated with this alternative. Implementability issues may include administrative delays in placing deed restrictions.

***Cost* -** The estimated capital cost for this alternative is $242,000. Annual OM&M costs for fence and cover system maintenance are estimated to be $905,000 resulting in an estimated 30-year present worth cost of $1,150,000.

6.2.1.3 Hudson Branch Alternative #3- Complete Excavation

This alternative excavates 9,600 yds^3 and would achieve the RAOs. Hudson Branch Alternative #3 is protective of human health and the environment, is compliant with ARARs, is long term effective and permanent, reduces mobility, and is implementable. However, because of the need for increased excavation for this alternative (compared to Alternative #4, for example) the implementability ranks poorer. Alternative #3 is the most expensive alternative for Hudson Branch, so it ranks poorly with the cost criteria. Because this alternative requires more trucking (due to the disposal of significantly more material) than Alternative #4, Alterative #3 will create more traffic noise and nuisance to the community, so Alternative #3 ranks worse than Alternative #4 for short term effectiveness. Although, this alternative is considered somewhat "green", the environmental footprint during and after remediation is larger than the benefits gained because the ecologic diversity is not protected (*e.g.* many large trees would be destroyed).

***Overall Protection of Human Health and the Environment* -** This alternative would be protective of human health and the environment, as it would eliminate the presence of contaminated sediment from the Hudson Branch.

***Compliance with ARARs* -** *Chemical-Specific ARARs:* This alternative would comply with ARARs because it permanently removes contaminated sediment from the Hudson Branch.

***Long-Term Effectiveness and Permanence* -** Under this alternative, no unacceptable residual risk would remain since constituent concentrations would be significantly and permanently reduced with no reliance on continued performance of remedial measures following cleanup.

***Reduction of Toxicity, Mobility, or Volume Through Treatment* –** Although this alternative is not treatment, excavation and off-site disposal of the sediment would effectively eliminate the toxicity, mobility, and volume of the contaminated sediments

***Short-Term Effectiveness* -** Significant short-term risks and disruption of the community are expected under this alternative. These include: excessive truck traffic, noise from heavy equipment use, the potential for spillage of the sediments during transport, odors; and biological risks from attraction of vectors (rodents, insects, gulls, etc.) during the excavation work. Site workers would be required to wear personal protective equipment (PPE) to prevent direct contact with the waste fill material during excavation. Wildlife disruption would occur across the Site. Dust and erosion control methods would be required during waste/fill handling activities. The Remedial Action Objectives would be achieved once the sediment is removed.

Implementability **-** Technical implementability issues associated with this alternative would depend in part on the actual volume of waste fill removed from the Site and the corresponding amount of truck traffic resulting from this approach. An estimated 12,500 yds^3 of sediments would need to leave the Site. Dust, erosion and odor controls would be required. Administrative implementability issues may be encountered in securing approval for disposal of the material at an off-site facility.

Cost **-** The capital costs associated with this alternative are estimated at $5,770,000. Total OM&M costs associated with backfilling and restoring the area are anticipated to be $260,000 resulting in an estimated 30-year present worth cost of $6,040,000.

6.2.1.4 Hudson Branch Alternative #4- Limited Excavation/Capping

This alternative includes excavation of a more limited 8,500 yds^3 of sediments within the channel to the depth of PRG exceedance, and the focused excavation/capping of overbank wetland/floodplain sediment exceeding PRGs. The focused excavation would entail the removal of a sufficient depth of sediment to allow cap installation. The excavation is necessary to ensure that floodplain areas are not filled by the capping in this remedial alternative.

This alternative would achieve the RAOs. This alternative ranks high in all criteria, except cost. Hudson Branch Alternative #4 is protective of human health and the environment, is compliant with ARARs, is long term effective and permanent, reduces mobility, ranks well with short term effectiveness, and is implementable. The cost for this alternative is moderate. Because there is a need for focused excavation and trucking for this alternative, there are some community impacts, which are unavoidable to accomplish RAOs. This affects the short term effectiveness, but this can be readily managed with conventional construction methods. This alternative is the most “green” of any Hudson Branch options, because this alternative balances the net benefits of protecting the ecology (*e.g.* targeting the most-impacted areas in the stream channel and low-value phragmites) while preserving the ecologic diversity (*e.g.* larger trees).

Overall Protection of Human Health and the Environment **-** This alternative would be protective of human health and the environment, as it would either eliminate the presence of contaminated sediments from the Hudson Branch that exceeds ecological PRGs or permanently contain them through a cap them.

***Compliance with ARARs* -** This alternative would comply with ARARs because it either permanently removes contaminated sediments from the Hudson Branch or caps them.

***Long-Term Effectiveness and Permanence* -** Under this alternative, no unacceptable residual risk would remain. Excavated contaminated sediments would be permanently removed. Capped sediments would be permanently isolated through installation and maintenance of capping.

***Reduction of Toxicity, Mobility, or Volume Through Treatment* –** Although this alternative does not include treatment, excavation and off-site disposal or capping of the sediment would effectively eliminate the potential for exposure of the sediments to ecological receptors.

***Short-Term Effectiveness* -** Significant short-term risks and disruption of the community are expected under this alternative primarily due to the excavation and off-Site disposal of contaminated sediments. These impacts include: excessive truck traffic, noise from heavy equipment use, the potential for spillage of the sediments during transport, odors; and biological risks from attraction of vectors (rodents, insects, gulls, etc.) during the excavation work. There is also likely to be disruption to the community through implementation of the capping due to the delivery of capping material, heavy equipment used to install the capping material and noise. Site workers would be required to wear personal protective equipment (PPE) to prevent direct contact with the sediments during excavation and installation of capping. Wildlife disruption would occur across the Site. Dust and erosion control methods would be required during waste fill handling activities. The Remedial Action Objectives would be achieved once the sediment is removed or capped.

***Implementability* -** An estimated 8,500 yds^3 of sediments would need to leave the Site. Dust, erosion and odor controls would be required. Administrative implementability issues may be encountered in securing approval for disposal of the material at an off-site facility.

***Cost* -** The capital costs associated with this alternative are estimated at $4,180,000. Total OM&M costs associated with maintaining the caps and backfilling and restoring the area are anticipated to be $310,000 resulting in an estimated 30-year present worth cost of $4,490,000.

6.3 Comparative Analysis

The remedial alternatives for the Facility Soils and Hudson Branch are discussed in the subsection below. The results of the detailed evaluation were used in this section to conduct a comparative analysis of Alternatives to identify the relative advantages and disadvantages of each Alternative. The results of this analysis could be used as a basis for recommending remedial Alternatives.

6.3.1 Facility Soils

There were four remedial alternatives retained in the evaluation discussed in Section 4.3.1, namely:

- Facility Soils Alternative #1- No action
- Facility Soils Alternative #2- Limited Additional Action
- Facility Soils Alternative #3- Additional Capping
- Facility Soil Alternative #4- Targeted Excavation

These alternatives are compared to each other, per each of the nine criteria (as well as green remediation principles), in the following subsections.

6.3.1.1 Overall Protection of Human Health and the Environment

The goal of this criterion is to either eliminate the toxicity of the soils or to prevent exposure by human and ecological receptors. Alternatives #3 and #4 can both achieve this criterion. Alternative #3 would prevent exposure by capping the remaining contaminated soil in the Eastern Storage Areas. This additional capping would increase human health protection by limiting direct contact from by trespassers. Alternative #4 would provide the same level of protection by permanently removing the contaminated soil. Alternative #2 would restrict access through the installation of additional fencing and a deed notice. However, this Alternative would have limited effect on ecological receptors. Alternative #1 would not be effective in addressing this criterion.

6.3.1.2 Compliance with ARARs

Both Alternatives #3 and #4 fully comply with ARARs. Alternative #3 caps contaminated soil in the Eastern Storage Areas, which achieves the human health and ecological PRGs and all other ARARs. Alternative #4 also achieves all ARARs, but instead of eliminating the exposure pathway, this alternative achieves ARARs by permanently excavating and disposing of the contaminated soil. Alternative #2 is less effective at achieving ARARs because it provides no protection for ecological receptors. Alternative #1 provides no protection for human or ecological receptors and therefore, is not in compliance with ARARs.

6.3.1.3 Long Term Effectiveness

Alternative #4 is excavation and off-Site disposal and therefore, provides the best long term effectiveness. Alternative #3 is installation of a cap. In order to be effective the cap will require maintenance which will include the planting and mowing of grass to prevent dust and erosion. If properly maintained, this alternative could be as effective in protecting human health and the environment. Alternative #2, the installation of additional fencing and a deed notice would only prevent human exposure and is therefore, not effective. Alternative #1, the “no action” alternative is not at all effective.

6.3.1.4 Reduction in Toxicity, Mobility or Volume Through Treatment

None of the alternatives would reduce the toxicity, mobility, or volume of contaminants through treatment since none of the proposed alternatives includes treatment. However, Alternative #4 best reduces the three parameters by permanently removing the contaminated soils from the Eastern Storage Areas via removal of targeted volumes of soil. None of the other three alternatives reduces any of the three parameters. However, Alternative #3, which is capping, prevents human exposure and Alternative #2, additional fencing and a deed notice, provides some protection to potential human receptors. Alternative #1, no action, provides no additional protection to human health or the environment.

6.3.1.5 Short-Term Effectiveness

Alternative #1, the no-action alternative, poses no additional short-term risks to the community, workers, or the environment. There would be no substantial risks on the community, workers, or the environment associated with implementation of Alternative #2. Fencing can be installed with relatively little disruption to the community. The fencing could be installed relatively quickly and installation would not require the heavy equipment required for the excavation or capping alternatives. Alternative #3, Additional Capping, would result in some short term effects on workers while the cap is being installed (2 months). However, a health and safety plan would be prepared and implemented which would maintain worker protections. There would also be some short-term effect on the community because cap material would need to be trucked into the Facility, but this impact is considered minimal. Under both Alternatives #3 and #4, workers would be required to wear PPE to prevent direct contact with the contaminated soil and airborne particulates. Alternative #4, Targeted Excavation, would provide the most significant short term effect on the community because it would require much more (approximately 10 times more than Alternative #3) truck traffic to accommodate off-Site disposal. There would be the most potential for worker exposure during construction (up to 24 months), but this would be addressed by a health and safety plan which would maintain worker protections.

6.3.1.6 Implementability

No significant technical implementability issues are associated with the Alternatives #1 and #2. Alternative #3 is also highly implementable because construction of a permeable cap is straightforward. Materials of construction and required construction equipment for a permeable cap are readily available. Alternative #4, Targeted Excavation, is also relatively highly implementable. Disposal sites for the contaminated soil and clean fill to backfill the excavation are available.

6.3.1.7 Cost

As stated earlier, the summary of conceptual cost estimates for the Hudson Branch and Facility Soil remedial alternatives is provided in Table 3. The conceptual cost estimates for each Facility Soil remedial alternative are presented in Table 5 (specifically 5-1, 5-2, 5-3, and 5-4).

Facility Soil Alternative #1—No Action has the lowest cost.

Facility Soil Alternative #2—Limited Additional Action has a relatively low cost. Total Present Value Project Costs are $880,000

Facility Soil Alternative #3—Additional Capping has a moderate cost. Total Present Value Project Costs are $960,000

Facility Soil Alternative #4—Targeted Excavation has the highest cost. Total Present Value Project Costs are $7,260,000.

6.3.1.8 State Acceptance

State acceptance is a modifying criterion, to be completed after the EPA selects a Proposed Plan.

6.3.1.9 Community Acceptance

Community acceptance is a modifying criterion, to be completed after the EPA selects a Proposed Plan.

6.3.1.10 Green Remediation Principles

Alternative #2, limited additional action, ranks relatively well against the Green Remediation Principles because it uses little energy, minimizes air emissions, and minimizes water use. However, it ranks poorly because it does not recycle and certainly does not protect land and the ecosystems. Alternative #3, additional capping, ranks well on Green Remediation Principles because it minimizes energy use, air emissions and water use (will be only temporary, during construction). Recycled products will be considered for the capping material. This alternative is also protective of the ecosystem because it reduces ecological exposures. Alternative #4, Targeted Excavation, ranks the poorest on Green Remediation Principles because it uses more energy and produces more emissions (though only in the short term) than the other alternatives. Some water use will likely be needed to dewater the excavation. The quantity of fill needed ranks poorly on the reduce/reuse/recycle concept because it will likely require a significant amount of virgin material. This alternative is protective of the ecosystem.

6.3.2 Hudson Branch

As discussed in Section 4.2, retained Hudson Branch Remedial Alternatives include:

- Hudson Branch Alternative #1—No Action
- Hudson Branch Alternative #2—Limited Action
- Hudson Branch Alternative #3— Complete Excavation
- Hudson Branch Alternative #4—Excavation/Capping

These remedial alternatives are compared to the evaluation criteria in the subsections below.

6.3.2.1 Overall Protection of Human Health and the Environment

No human health risk above established ranges exists, so each alternative is equally protective of human health.

Alternative #4, Excavation/Capping, would be very effective in protecting the environment because it achieves ecological PRGs while preserving higher value vegetation/habitat. Excavation permanently removes the contaminated sediment, so it is fully protective. Capping can also be effective, if the capping is maintained to assure that it does not erode. Alternative #3, Complete Excavation, would be at least equally effective at removing the contaminant mass and therefore, the threat to ecological receptors due to the contaminated sediments. However, preserving the existing ecosystem is an additional consideration this alternative. Since it would remove higher value vegetation/habitat, this alternative is considered less protective. Alternative #2, Limited Action, would not be very effective in protecting the environment. While a component of this alternative is MNR, it is unclear whether to what extent the toxicity and/or mobility of the contaminated sediments would be affected and even if there was some effect, the time frame to achieving the PRGs would be excessive. Alternative #1, No Action, would not be effective in protecting the environment because it does not achieve ecological PRGs.

6.3.2.2 Compliance with ARARs

Because promulgated standards for sediments do not exist, there are no directly applicable ARARs. The PRGs reflect levels that are protective.

Hudson Branch Alternative #1—No Action is not compliant with PRGs.

Hudson Branch Alternative #2—Limited Action is not compliant with PRGs in a suitable timeframe.

Hudson Branch Alternative #3— Complete Excavation will achieve PRGs.

Hudson Branch Alternative #4—Excavation/Capping will achieve PRGs.

6.3.2.3 Long-Term Effectiveness and Permanence

Hudson Branch Alternative #1—No Action is not applicable to long-term effectiveness or permanence because no remedial action is implemented.

Hudson Branch Alternative #2—Limited Action does not achieve long-term effectiveness or permanence in a reasonable time frame.

Hudson Branch Alternative #3— Complete Excavation achieves long term effectiveness and permanence.

Hudson Branch Alternative #4—Excavation/Capping achieves long-term effectiveness because it removes significant heavy metal mass from the stream areas and protects ecological receptors in a permanent manner. Because alternative #4 better preserves ecological diversity, it ranks better than the other alternatives for long term effectiveness; Alternative #4 is the best combination of remedial actions.

6.3.2.4 Reduction in Toxicity, Mobility Through Treatment

None of the alternatives would reduce the toxicity, mobility, or volume of contaminants through treatment since no significant treatment would occur. Alternatives #3 and #4 may provide some treatment, if, in the unexpected case (based on sampling) hazardous characteristics are found in excavated material.

Hudson Branch Alternative #1—No Action would result in no treatment and therefore, no reduction in toxicity or mobility, so it does not satisfy this criterion.

Hudson Branch Alternative #2—Limited Action would result in contaminant reduction, but would do so over an unsuitably long time, so it does not satisfy this criterion.

Hudson Branch Alternative #3— Complete Excavation would reduce toxicity (via offsite disposal) so it satisfies this criterion.

Hudson Branch Alternative #4—Excavation/Capping would result in reduction of toxicity (via offsite disposal) and mobility (via capping) so it satisfies this criterion.

6.3.2.5 Short-Term Effectiveness

Hudson Branch Alternative #1—No Action would have no short term impact on the community or workers.

Hudson Branch Alternative #2—Limited Action would have minimal short term effect on the community or workers during construction (2 months).

Hudson Branch Alternative #3— Complete Excavation would have significant short term impact on the community because it requires accessing the stream with construction equipment to complete the required work. The expected construction duration is 30 months. This would create noise and a visual presence. Further, this alternative would generate the largest volume of excavated material to be trucked offsite. Workers would be potentially exposed during the work, but would be protected by a health and safety plan.

Hudson Branch Alternative #4—Excavation/Capping offers good balance because the capping and monitoring components help to reduce some short term impacts by reducing trucking. The expected construction duration is 24 months. So, Alternative #4 ranks well against the short term effectiveness criterion.

6.3.2.6 Implementability

Hudson Branch Alternative #1—No Action and Alternative #2—Limited Action are easily implementable.

Alternatives #2, #3, and #4 would require permit equivalents for land use concerns (wetland and flood plain). These permits are routinely obtained from the state.

Hudson Branch Alternative #3— Complete Excavation is implementable, though it ranks worse than Alternative #4 because the extra trucking needed. Construction techniques are common and well understood, but alternative #3 is the most-intrusive and most-challenging to implement. Materials are commercially available.

Hudson Branch Alternative #4—Excavation/Capping is implementable. Construction techniques are common and well understood. Materials are commercially available.

6.3.2.7 Cost

As stated earlier, the summary of conceptual cost estimates for the Hudson Branch and Facility Soil remedial alternatives is provided in Table 3. The conceptual cost estimates for each Hudson Branch remedial alternative are presented in Table 4 (specifically 4-1, 4-2, 4-3, and 4-4).

Hudson Branch Alternative #1—No Action would have the lowest cost.

Hudson Branch Alternative #2—Limited Action would have a moderate cost, including the capital cost and O&M for only a fence and monitoring. Total Present Value Project Costs are $1,150,000.

Hudson Branch Alternative #3— Complete Excavation has the highest capital cost, but somewhat lesser O&M costs than Alternative #4. Total Present Value Project Costs are $6,040,000.

Hudson Branch Alternative #4—Excavation/Capping has moderately high costs. Total Present Value Project Costs are $4,490,000.

6.3.2.8 State Acceptance

State acceptance is a modifying criterion, to be completed after the EPA selects a Proposed Plan.

6.3.2.9 Community Acceptance

Community acceptance is a modifying criterion, to be completed after the EPA selects a Proposed Plan.

6.3.2.10 Green Remediation Principles

Alternative #4, Excavation/Capping ranks the highest on Green Remediation Principles because it provides the best balance of protecting ecology, maintaining ecological diversity (by saving larger trees), using less energy, and producing less emissions than Alternative #3. Some water use will likely be needed to dewater the excavation. Recycled products will be considered for the capping material. Alternative #3, Complete Excavation, ranks well or reasonably well on Green Remediation Principles because it protects the ecology. However, it ranks poorly (compared to Alternative #4) because it does not minimize energy use, air emissions and water use (during construction). The quantity of fill needed ranks poorly on the reduce/reuse/recycle concept because it will likely require a significant amount of virgin material. This alternative is not fully protective of the ecosystem because it does not preserve larger trees, and therefore threatens the ecological diversity. Alternative #2, Limited Action, ranks relatively poorly against the Green Remediation Principles because it does not protect the ecology. This alternative uses little energy, minimizes air emissions, and minimizes water use, however, it ranks poorly on Green Remediation Principles because it does not recycle and certainly does not protect land and the ecosystem.

7. CONCLUSIONS

This Revised Draft FS identifies and evaluates an array of remedies to clean up the areas of the Site with identified risk in a manner suitable to support the selection of a Proposed Plan.

8. REFERENCES

TRC, OU2 Site Characterization Study Report, 2012a.

TRC, OU2 Baseline Ecological Risk Assessment, 2013a.

TRC, OU2 Baseline Human Health Risk Assessment, 2013b.

EPA, Contaminated Sediment Remediation Guidance for Hazardous Waste Sites, Office of Solid Waste and Emergency Response, EPA-540-R-05-012, December 2005.

ACOE, Technical Guidelines for Environmental Dredging of Contaminated Sediments, 2008.

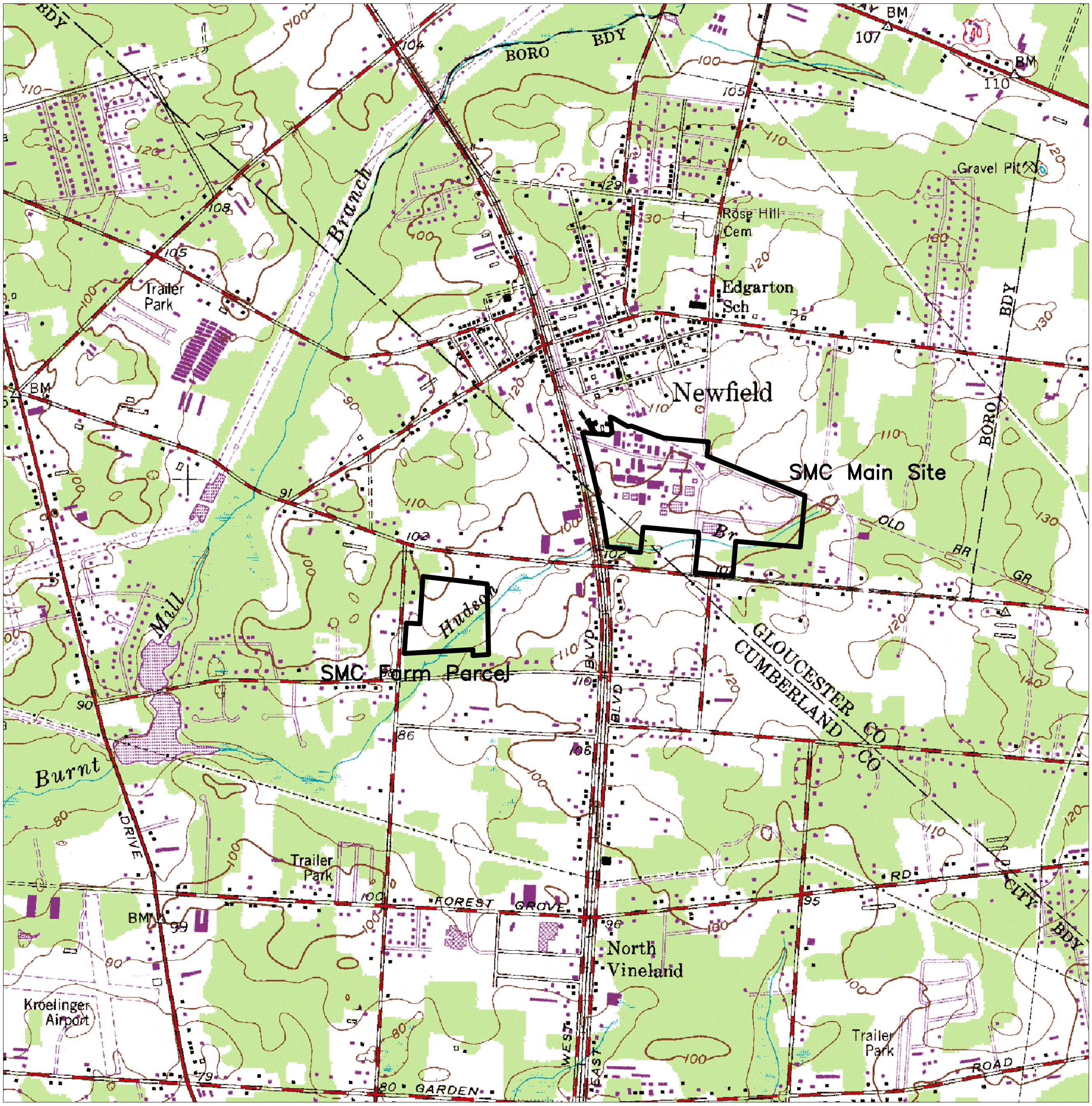
EPA, Assessment and Remediation of Contaminated Sediment (ARCS) Program Guidance for In-Situ Subaqueous Capping of Contaminated Sediments and the Assessment and Remediation of Contaminated Sediments (ARCS) Program Remediation Guidance Document, 1998.

EPA, "Terms of Environment" (http://www.epa.gov/roe/glossary.htm)

EPA, Comments on Draft OU2 RI, 2013.

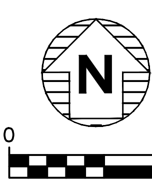
NJDEP, Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria, September 2012.

FIGURES



SOURCE: NEWFIELD, N.J. QUADRANGLE, 1953, PHOTOREVISED 1994,
7.5 MINUTE SERIES (USGS TOPOGRAPHIC MAP)

SITE PROPERTY BOUNDARY



APPROXIMATE SCALE

QUADRANGLE LOCATION

TRC ENVIRONMENTAL CORP.
57 East Willow Street
Millburn, New Jersey 07041

SITE LOCATION MAP

SHIELDALLOY METALLURGICAL CORPORATION
NEWFIELD, NEW JERSEY

JOB NO.: 2710ES-112434

BR/TH	DATE: FEBRUARY 2013	FIGURE: 1

M:\CAD FILES\WORK\2710ES\2013 OU2 FS\FIGURE 1 SITE LOCATION MAP.DWG 07/19/2013 02:16:37PM TAB: LAYOUT

R2-0003365

PROPERTY LINE
SHIELDALLOY METALLURGICAL CORPORATION FACILITY
RESTRICTED AREA
CONCRETE TANK FOUNDATIONS AND PAD
FORMER WOOD LINED TANK
WWTP
POND
NEWFIELD BOROUGH
CITY OF VINELAND
RR TRACKS
WEST BOULEVARD
EAST BOULEVARD
HUDSON BRANCH
GLOUCESTER COUNTY
CUMBERLAND COUNTY
WEYMOUTH ROAD
E. WEYMOUTH
PROSPECT AVENUE
DIVISION STREET
E. ARBOR STREET
W. ARBOR STREET
N. WEST AVENUE
LACROCE PROPERTY
SHIELDALLOY METALLURGICAL CORPORATION FARM PARCEL
PUMPING STATION
EXISTING DIRT ROAD
OPEN GARAGE
HORSE ENCLOSURE
WHEATON INDUSTRIES
NORTH VINELAND CAR WASH
FISCHER & PORTER
RESEARCH GLASS
PAVEMENT EDGE
LEGEND
NATURAL RESOURCE RESTORATION PLANTING AREAS (NOTE: THESE AREAS WERE CAPPED UNDER REGULATORY LEGAL AGREEMENTS WITH 1–2' OF CLEAN SOIL AND VEGETATION, IN 1999 AND 2001. DATA SHOWN IS BELOW THE CAP.)
RESTRICTED AREA
EASTERN STORAGE AREA
FORMER LAGOON AREA
FORMER PRODUCTION AREA
SOUTHERN AREA
UNCAPPED AREA
EXISTING BUILDING FOOTPRINT
DEMOLISHED BUILDING FOOTPRINT
ITEMS REMOVED/CLOSED
PROPERTY LINE
FENCE LINE
WETLAND LIMITS
WETLAND BUFFER
100 YR FLOODPLAIN*
DELINEATED STREAM
VEGETATIVE AREA INCLUDING GRASS, TREES AND DIRT ROADS
FORMER PRODUCTION AREA WITH CONCRETE, ASPHALT, BUILDING SLAB, AND SOIL COVER.
FORMER LAGOON WITH SOIL COVER BETWEEN 32" AND 98" (EXCAVATED FROM 32" TO 98". THEN BACKFILLED FROM 32" TO 98" WITH CERTIFIED CLEAN FILL).
FORMER LAGOON WITH LIMITED EXCAVATION. CLEAN SOIL COVER EXTENDS TO 3' IN EXCAVATED AREAS.
* BASED ON 2010 FIS IN NEWFIELD NEW JERSEY. VINELAND'S LAST FIS WAS IN 1982 AND DID NOT CLASSIFY THE UPPER HUDSON BRANCH AS HAVING ANY 100 YR FLOOD RISK.
SOURCE:
BASE MAP FROM JAMES M. STEWART, INC., LAND SURVEYORS, PHILADELPHIA, PA. AND ON-SITE OBSERVATIONS.
LACROCE PROPERTY BOUNDARY BASED ON TAX MAP-CITY OF VINELAND, OCTOBER 1, 1971.
ORTHOPHOTOS FROM NEW JERSEY IMAGE WAREHOUSE WEB SITE, PUBLISHED 7/31/2003 WITH PHOTO TAKEN IN 2002.
0 120' 240'
GRAPHIC SCALE
TRC ENVIRONMENTAL CORP.
1500 Market Street
Philadelphia, PA 19102
SITE PLAN
SHIELDALLOY METALLURGICAL CORPORATION
NEWFIELD, NEW JERSEY
JOB NUMBER: 112434
JG/PZ
DATE: FEBRUARY 2013
FIGURE: 2

R2-0003366

SOURCE:

BASE MAP FROM JAMES M. STEWART, INC., LAND SURVEYORS, PHILADELPHIA, PA. AND ON–SITE OBSERVATIONS.
LACROCE PROPERTY BOUNDARY BASED ON TAX MAP–CITY OF VINELAND, OCTOBER 1, 1971.
ORTHOPHOTOS FROM NEW JERSEY IMAGE WAREHOUSE WEB SITE, PUBLISHED 7/31/2003 WITH PHOTO TAKEN IN 2002.

NOTE:

EXTENTS OF SEDIMENT CONCERNS IN HUDSON BRANCH IS BASED ON SEDIMENT DATA EXCEEDING ECOLOGICAL PRGS, SOIL BANK DATA, WETLAND LIMITS, AND LOCALIZED TOPOGRAPHY. ALSO, THE UNCAPPED AREA IS SITE SOIL EXCEEDING HUMAN HEALTH AND ECOLOGICAL PRGS FOR VANADIUM, THAT ARE NOT ALREADY CAPPED.

LEGEND

PROPERTY LINE
FENCE LINE
APPROXIMATE PHRAGMITES
DELINEATED STREAM
WETLAND LIMITS
100 YR FLOODPLAIN*
RESTRICTED AREA
VEGETATIVE AREA INCLUDING GRASS, TREES AND DIRT ROADS
FORMER PRODUCTION AREA WITH EXISTING CONCRETE, ASPHALT, BUILDING SLAB, AND SOIL COVER.
FORMER LAGOON WITH SOIL COVER BETWEEN 32"AND 98" (EXCAVATED FROM 32" TO 98". THEN BACKFILLED FROM 32" TO 98" WITH CERTIFIED CLEAN FILL).
FORMER LAGOON WITH LIMITED EXCAVATION. CLEAN SOIL COVER EXTENDS TO 3' IN EXCAVATED AREAS.
UNCAPPED AREA OF EASTERN STORAGE AREA EXCEEDING PRGs
EXTENTS OF FACILITY SOILS EXCEEDING PRGs OR ARARs
EXISTING NATURAL RESOURCE RESTORATION PLANTING AREA
EXISTING BUILDING FOOTPRINT
DEMOLISHED BUILDING FOOTPRINT
ITEMS REMOVED/CLOSED
EXTENTS OF HUDSON BRANCH SEDIMENT EXCEEDING PRGs

* BASED ON 2010 FIS IN NEWFIELD NEW JERSEY. VINELAND'S LAST FIS WAS IN 1982 AND DID NOT CLASSIFY THE UPPER HUDSON BRANCH AS HAVING ANY 100 YR FLOOD RISK.

0 120' 240'
GRAPHIC SCALE

TRC ENVIRONMENTAL CORP.
1500 Market Street
Philadelphia, PA 19102

AREAS REQUIRING REMEDIAL ATTENTION

SHIELDALLOY METALLURGICAL CORPORATION
NEWFIELD, NEW JERSEY

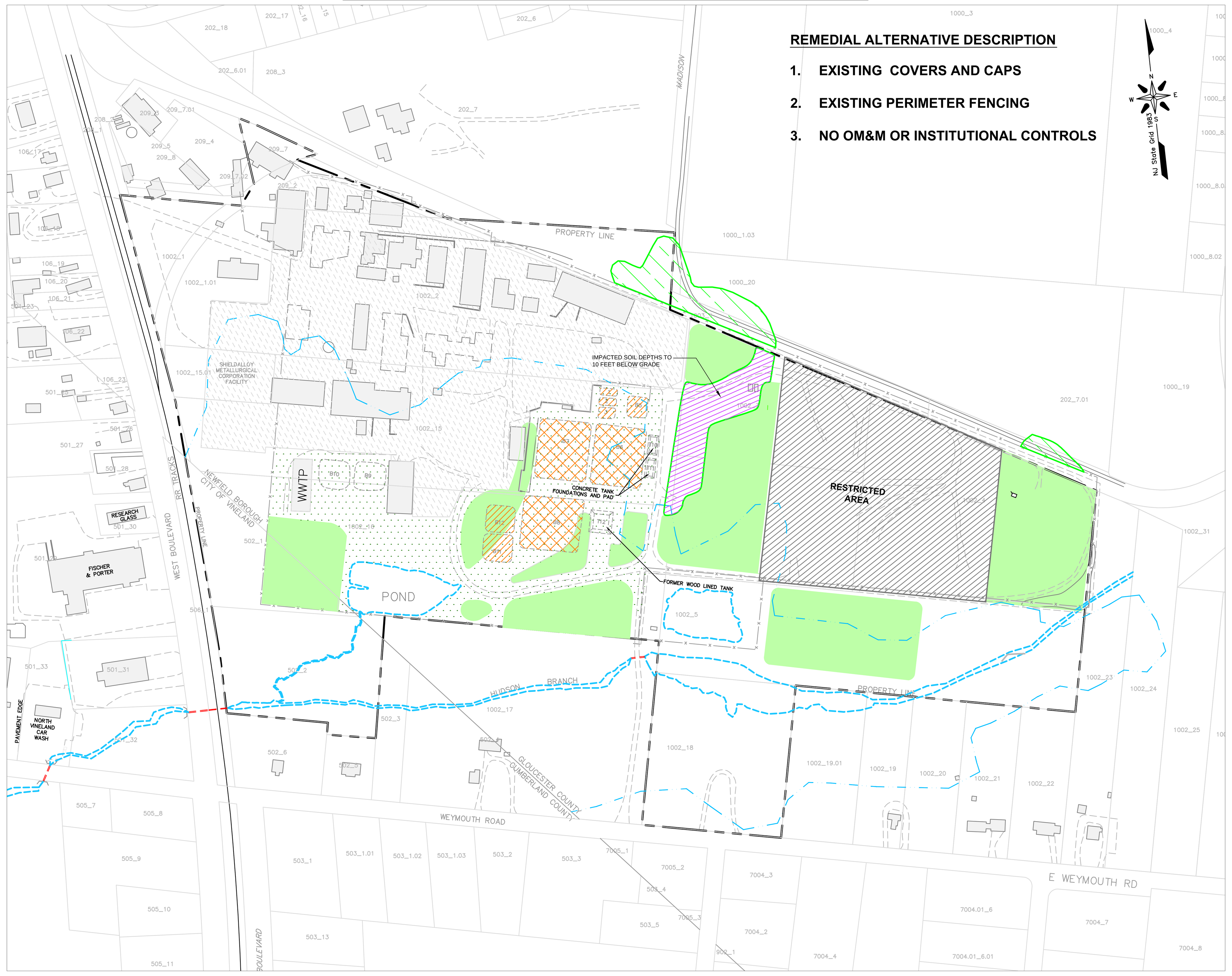
JOB NUMBER: 112434

JG/PZ	DATE: JULY 2013	FIGURE: 3

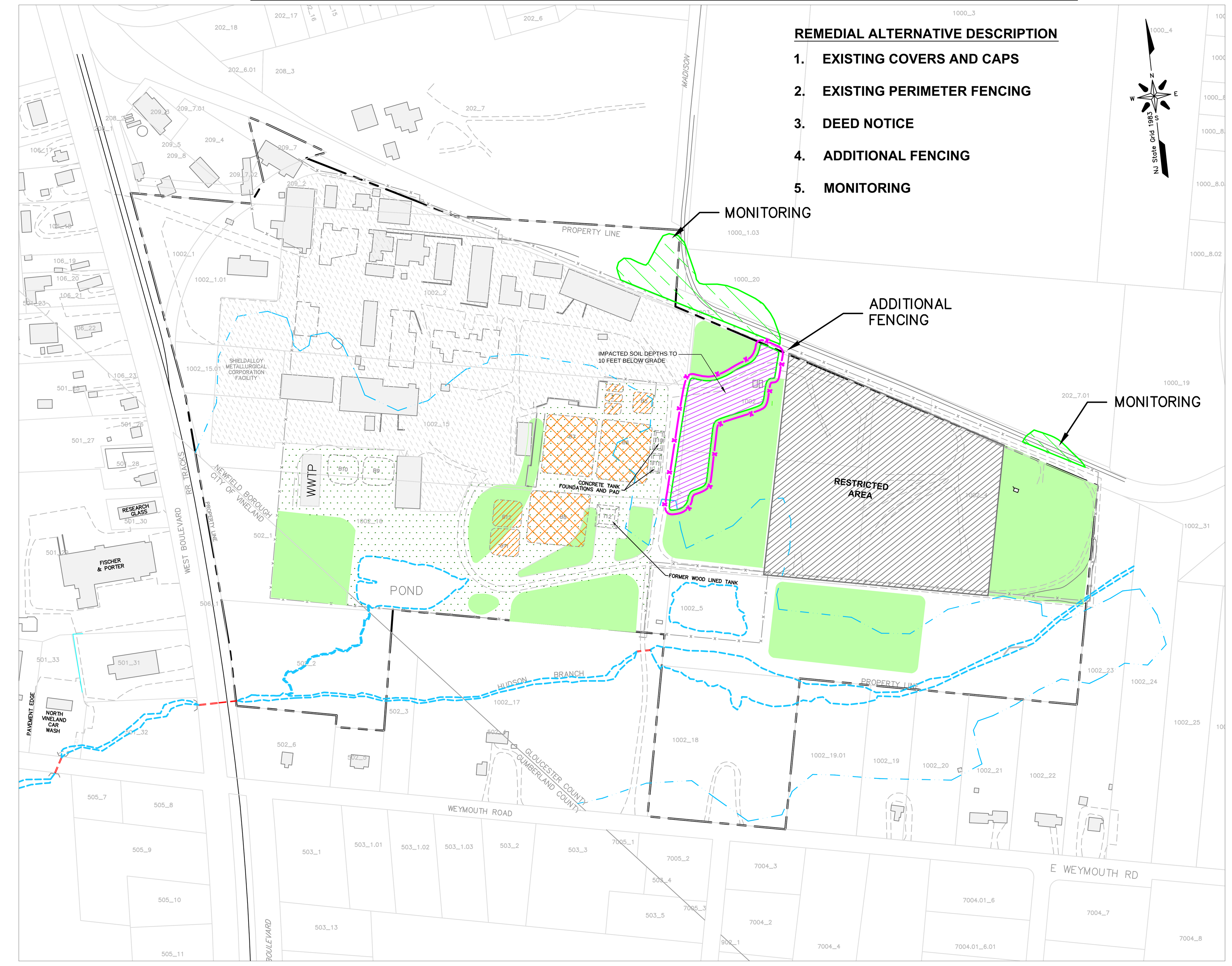
FILE: W:\CAD FILES\WORK\27105\2013 OU2 FS\FIGURE 3- OU2 KEY SITE AREAS-REV3.DWG, DATE: 07/19/2013 01:25:08PM

R2-0003367

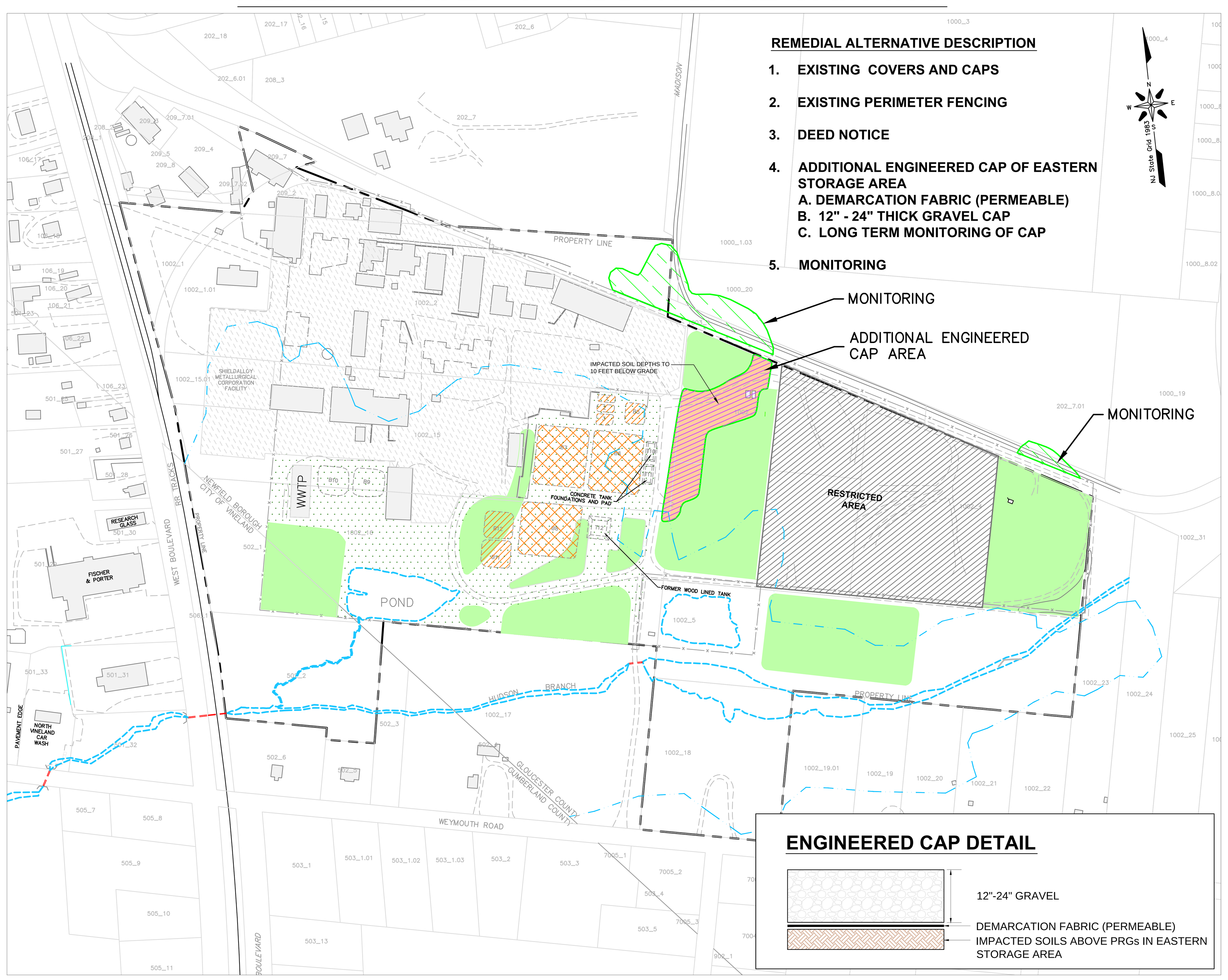
ALTERNATIVE #1 - NO ACTION



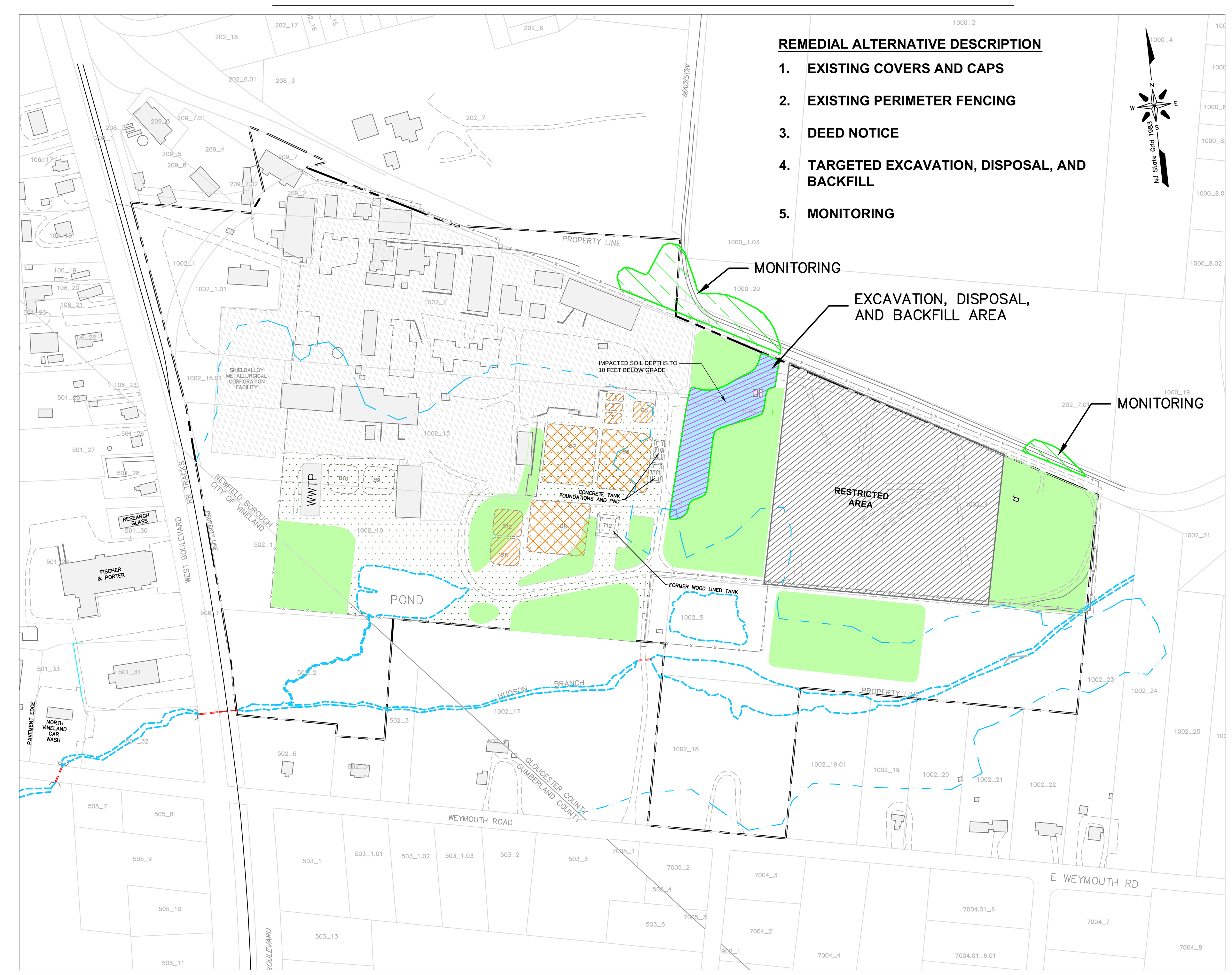
ALTERNATIVE #2 - LIMITED ADDITIONAL ACTION



ALTERNATIVE #3 - ADDITIONAL CAPPING



ALTERNATIVE #4 - TARGETED EXCAVATION



LEGEND

- PROPERTY LINE
- FENCE LINE
- ADDITIONAL FENCE LINE
- 100 YR FLOODPLAIN*
- UNCAPPED AREA EXCEEDING PRGs OR ARARs
- ADDITIONAL ENGINEERED CAP TO BE INSTALLED ON THE EASTERN STORAGE AREA EXCEEDING PRGs OR ARARs
- EXCAVATION DISPOSAL AND BACKFILL OF THE EASTERN STORAGE AREA EXCEEDING PRGs OR ARARs
- EXTENTS OF FACILITY SOILS EXCEEDING PRGs OR ARARs (MONITORING)
- NATURAL RESOURCE RESTORATION PLANTING AREA
- RESTRICTED AREA
- VEGETATIVE AREA INCLUDING GRASS, TREES AND DIRT ROADS
- FORMER PRODUCTION AREA WITH CONCRETE, ASPHALT, BUILDING SLAB, AND SOIL COVER.
- FORMER LAGOON WITH SOIL COVER BETWEEN 32"AND 98" (EXCAVATED FROM 32" TO 98". THEN BACKFILLED FROM 32" TO 98" WITH CERTIFIED CLEAN FILL).
- FORMER LAGOON WITH LIMITED EXCAVATION. CLEAN SOIL COVER EXTENDS TO 3' IN EXCAVATED AREAS.

SOURCE:
BASE MAP FROM JAMES M. STEWART, INC., LAND SURVEYORS, PHILADELPHIA, PA. AND ON-SITE OBSERVATIONS.

0 200 400
GRAPHIC SCALE

TRC ENVIRONMENTAL CORP.
1500 Market Street
Philadelphia, PA 19102

FACILITY SOIL REMEDIAL ALTERNATIVES

SHIELDALLOY METALLURGICAL CORPORATION
NEWFIELD, NEW JERSEY

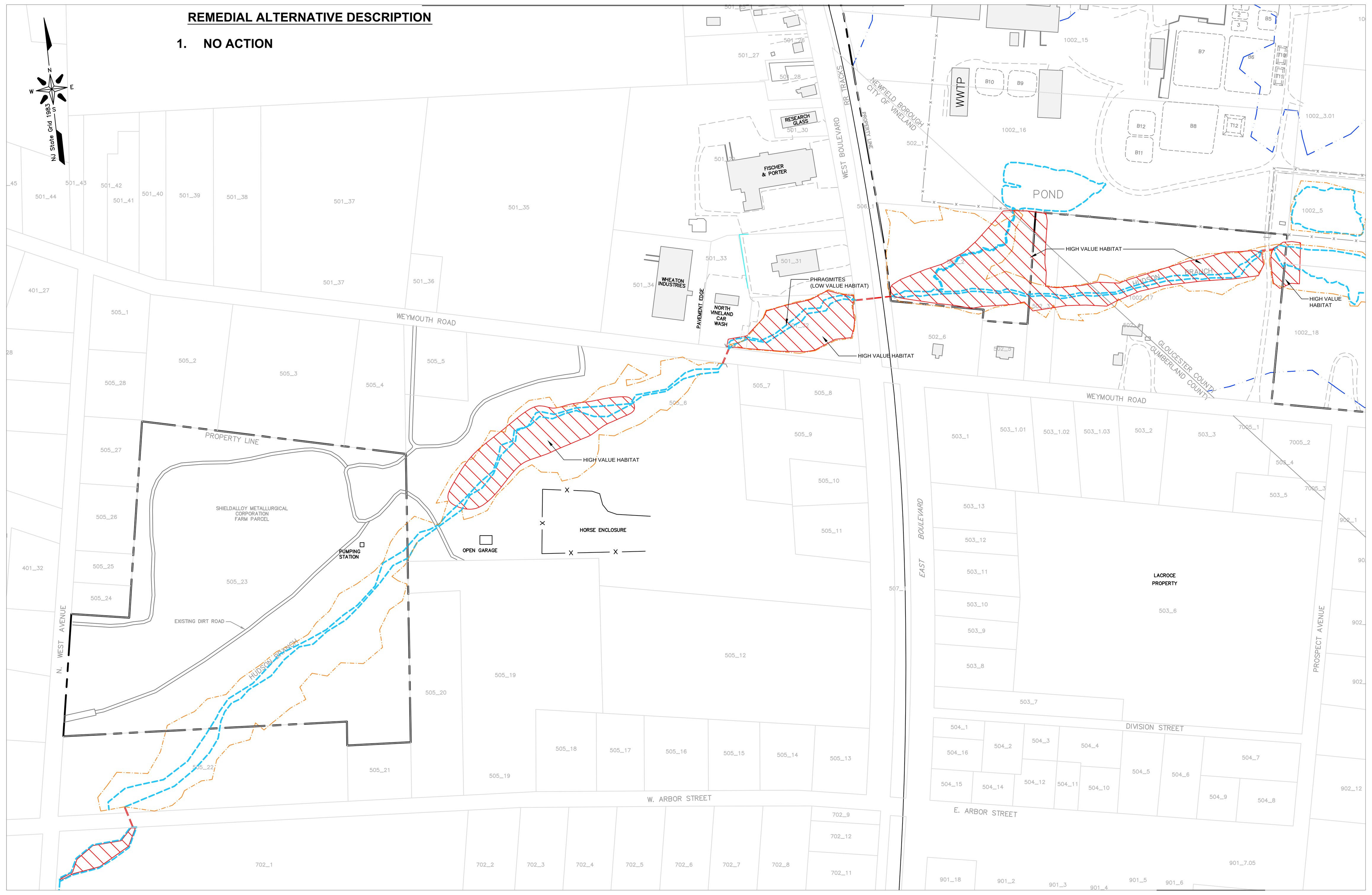
JOB NUMBER: 112434

JP/PZ	DATE: JULY 2013	FIGURE: 4

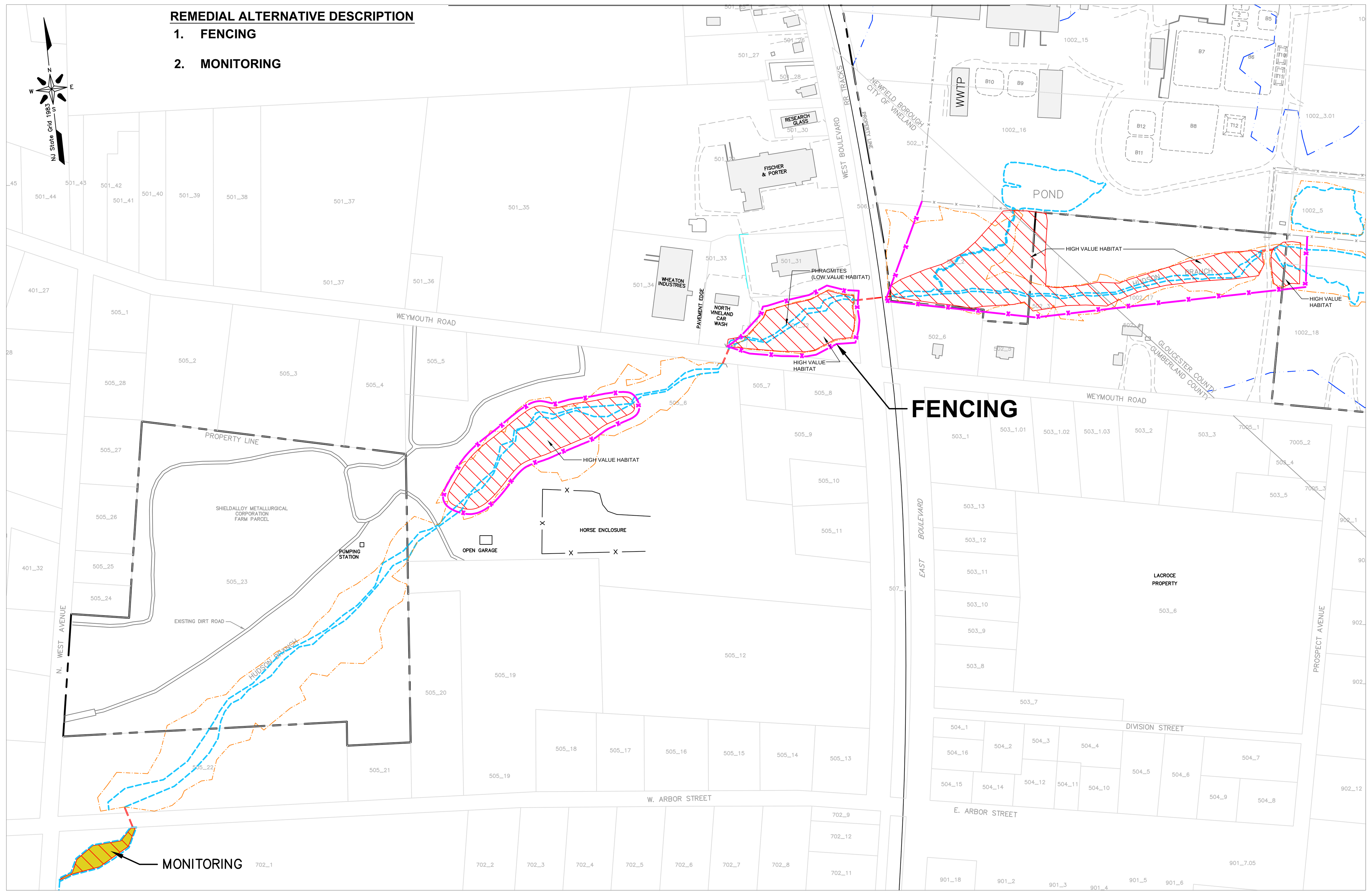
FILE: M:\CAD FILES\WORK\2710ES\2013 OU2 FS\FIGURE 4 – SOIL RA DESRIPTIONS.DWG, DATE: 09/04/2013 05:48:38PM

R2-0003368

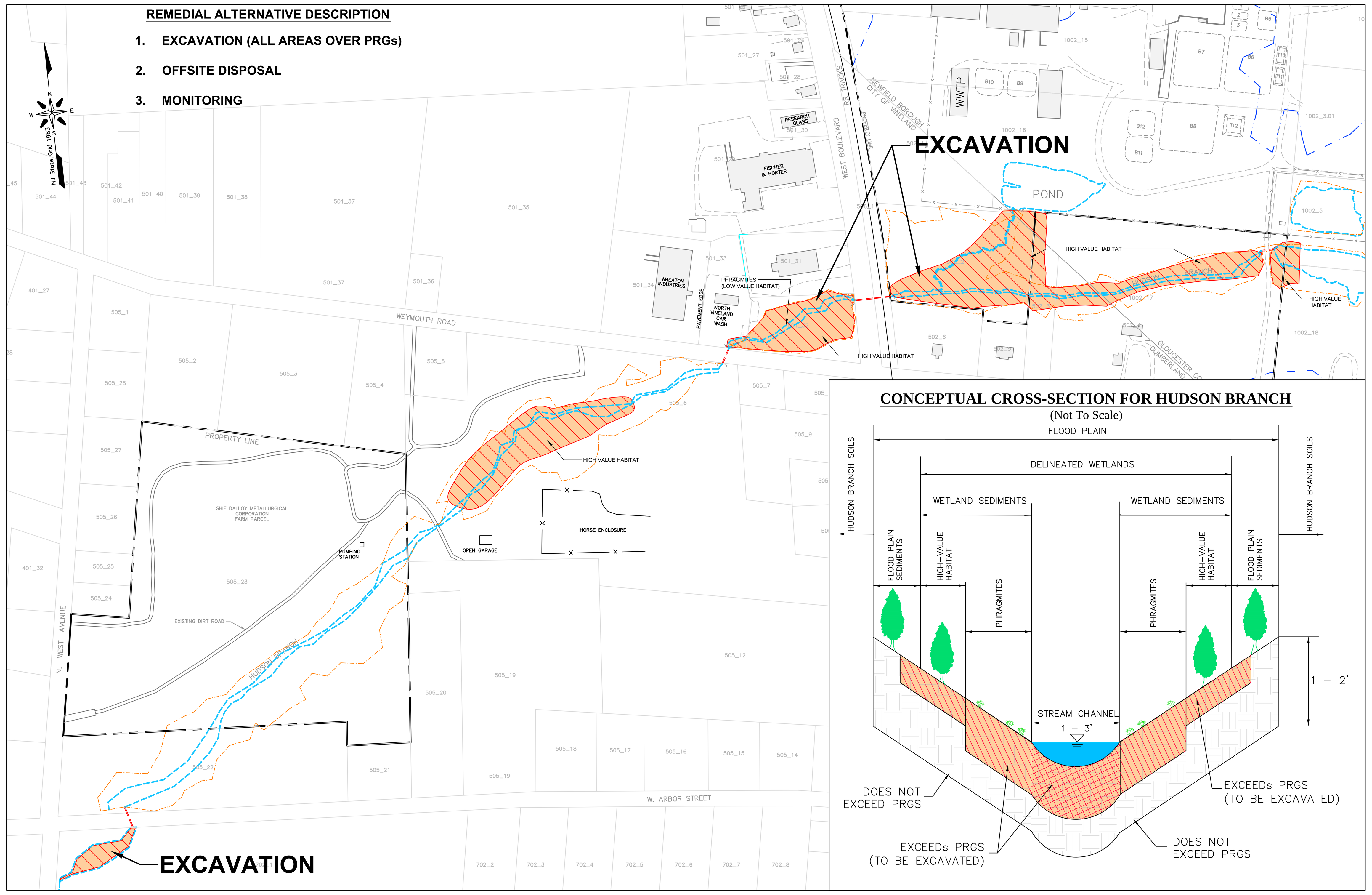
ALTERNATIVE #1 - NO ACTION



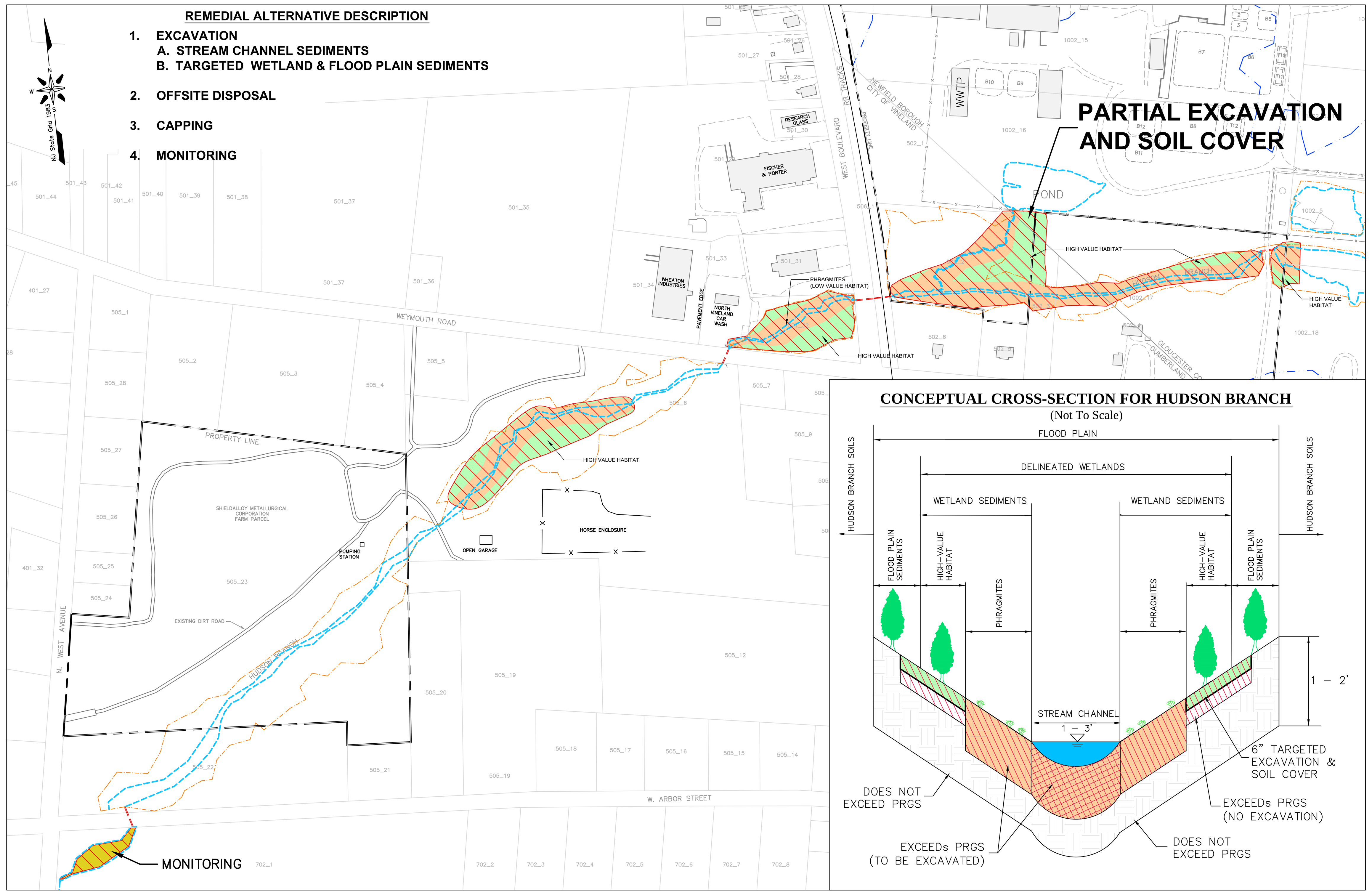
ALTERNATIVE #2 - LIMITED ACTION



ALTERNATIVE #3 - EXCAVATION OF ALL AREAS EXCEEDING PRGs



ALTERNATIVE #4 - EXCAVATION OF CHANNEL AND TARGETED OVERBANK



LEGEND

- PROPERTY LINE
- FENCE LINE
- ADDITIONAL FENCE LINE
- 100 YR FLOODPLAIN
- WETLAND LIMITS
- HUDSON BRANCH STREAM
- AREA EXCEEDING PRGs
- SEDIMENTS (STREAM CHANNEL, WETLANDS, FLOOD PLAIN) EXCEEDING PRGs TO BE EXCAVATED
- WETLAND AND FLOOD PLAIN SEDIMENTS EXCEEDING PRGs WITH TARGETED EXCAVATION AND SOIL COVER
- AREA EXCEEDING PRGs TO BE MONITORED

LEGEND FOR CONCEPTUAL CROSS SECTIONS

- WETLAND SEDIMENTS EXCEEDING PRGs TO BE EXCAVATED
- STREAM CHANNEL SEDIMENTS EXCEEDING PRGs TO BE EXCAVATED
- WETLAND AND FLOOD PLAIN SEDIMENTS EXCEEDING PRGs WITH TARGETED EXCAVATION AND SOIL COVER
- WETLAND AND FLOOD PLAIN SEDIMENTS EXCEEDING PRGs (NO EXCAVATION)
- HUDSON BRANCH STREAM

0 200 400
GRAPHIC SCALE

SOURCE:
BASE MAP FROM JAMES M. STEWART, INC., LAND SURVEYORS, PHILADELPHIA, PA. AND ON-SITE OBSERVATIONS.

TRC ENVIRONMENTAL CORP.
1500 Market Street
Philadelphia, PA 19102

HUDSON BRANCH REMEDIAL ALTERNATIVES

SHIELDALLOY METALLURGICAL CORPORATION
NEWFIELD, NEW JERSEY

JOB NUMBER: 112434

BL/MG	DATE: JULY 2013	FIGURE: 5

FILE: M:\CAD FILES\WORK\2710ES\2013 OU2 FS\FIGURE 5 – STREAM RA DESCRIPTIONS.DWG, DATE: 09/04/2013 05:45:50PM

R2-0003369

Table 3

Summary of Conceptual Cost Estimate

Facility Soil and Hudson Branch Remedial Alternatives

Shieldalloy Metallurgical Superfund Site; Newfield, NJ

Facility Soils

	Alternative #1--No Action	**Alternative #2--Limited Additional Action**	**Alternative #3--Additional Capping**	**Alternative #4--Targeted Excavation**
		Additional Fencing	Targeted cap	Targeted excavation
		Maintain Existing Fencing	Maintain Existing Fencing	Maintain Existing Fencing
		Maintain Existing Caps/Covers	Maintain Existing Caps/Covers	Maintain Existing Caps/Covers
		Deed Notice	Deed Notice	Deed Notice
Capital Cost	$ -	$ 170,000	$ 280,000	$ 6,570,000
OMM Cost (non-NPV)	$ 18,000	$ 710,000	$ 680,000	$ 690,000
Total	**$ 18,000**	**$ 880,000**	**$ 960,000**	**$ 7,260,000**

Hudson Branch

	Alternative #1--No Action	**Alternative #2--Limited Action**	**Alternative #3--Complete Excavation**	**Alternative #4--Excavation/Capping**
			Excavation (everything > PRGs)	Excavate targeted areas, targeted depth
		Fencing		Cap to preserve large trees
		Monitoring	Monitoring	Monitoring
Capital Cost	$ -	$ 240,000	$ 5,770,000	$ 4,180,000
OMM Cost (non-NPV)	$ 18,000	$ 900,000	$ 260,000	$ 310,000
Total	**$ 18,000**	**$ 1,150,000**	**$ 6,040,000**	**$ 4,490,000**

Table 4-1
Conceptual Cost Estimate
Facility Soil Remedial Alternative #1: No Action
Shieldalloy Metallurgical Superfund Site; Newfield, NJ

Remedial Alternative Description:

No action. Used as baseline for comparison of other alternatives, as required by Superfund.

CAPITAL COSTS

Item	Estimated Quantity	Units	Unit Rate	Total Cost
Controls				
None	-	ft	$ -	$ -
		Subtotal Direct Construction Costs		$ -
		Contingency	20%	$ -
		Project Management	10%	$ -
		Remedial Design	20%	$ -
		Construction Management	15%	$ -
		Legal and Administrative	5%	$ -
		EPA Oversight Fees	5%	$ -
		TOTAL CONSTRUCTION COSTS		**$ -**

Cost for "No Action" is zero dollars

Table 4-1

Conceptual Cost Estimate

Facility Soil Remedial Alternative #1: No Action

Shieldalloy Metallurgical Superfund Site; Newfield, NJ

Remedial Alternative Description:

No action. Used as baseline for comparison of other alternatives, as required by Superfund.

O&M COSTS

Item	Frequency	Quantity	Units	Rate/Cost Per Event		Total Cost		Note
5-year review	1	1	LS	$	10,000	$	10,000	
			Sub-Total OM&M (30 Years):			$	10,000	
			Contingency	20%		$	2,000	
			Project Management	10%		$	1,000	
			Remedial Design	20%		$	2,000	
			Construction Management	15%		$	1,500	
			Legal and Administrative	5%		$	500	
			EPA Oversight Fees	5%		$	500	
			TOTAL OM&M COSTS:			**$**	**17,500**	
			TOTAL PROJECT COSTS (UNADJUSTED FOR NPV):			**$**	**17,500**	

O&M NPV ANALYSIS

Sub-Total OM&M (30 Years):			$12,500
O&M COSTS			
Contingency	20%	$	2,500
Project Management	10%	$	1,250
Remedial Design	20%	$	2,500
Construction Management	15%	$	1,875
Legal and Administrative	5%	$	625
EPA Oversight Fees	5%	$	625
TOTAL NPV OM&M COSTS:			$22,000
TOTAL PRESENT VALUE PROJECT COSTS:		**$**	**22,000**

Table 4-2
Conceptual Cost Estimate
Facility Soil Remedial Alternative #2: Limited Additional Action
Shieldalloy Metallurgical Superfund Site; Newfield, NJ

Remedial Alternative Description:

Additional Fencing, maintain existing fence, maintain existing caps/covers, deed notice, and monitoring.

CAPITAL COSTS

Item	Estimated Quantity	Units	Unit Rate		Total Cost	
Controls						
Fencing	2,000	ft	$	23	$	46,000
Deed notice	1	LS	$	50,000	$	50,000
			Subtotal Direct Construction Costs		$	96,000
	Contingency		20%		$	19,200
	Project Management		10%		$	9,600
	Remedial Design		20%		$	19,200
	Construction Management		15%		$	14,400
	Legal and Administrative		5%		$	4,800
	EPA Oversight Fees		5%		$	4,800
			TOTAL CONSTRUCTION COSTS		**$**	**168,000**

Table 4-2

Conceptual Cost Estimate

Facility Soil Remedial Alternative #2: Limited Additional Action

Shieldalloy Metallurgical Superfund Site; Newfield, NJ

Remedial Alternative Description:

Additional Fencing, maintain existing fence, maintain existing caps/covers, deed notice, and monitoring.

O&M COSTS

Item	Frequency	Quantity		Units		Rate/Cost Per Event		Total Cost	Note
Inspection/repair--all fencing	30	86	LF	LS	$	23	$	59,000	Repair 1% of the fence every year for 30 years
Inspection/repair--all caps/covers	30	0.7	acre	LS	$	15,000	$	306,000	Repair 1% of the areas every year for 30 years
Monitoring	1	30		LS	$	1,000	$	30,000	
5-year review	1	1		LS	$	10,000	$	10,000	

Sub-Total OM&M (30 Years):		$	405,000
Contingency	20%	$	81,000
Project Management	10%	$	40,500
Remedial Design	20%	$	81,000
Construction Management	15%	$	60,750
Legal and Administrative	5%	$	20,250
EPA Oversight Fees	5%	$	20,250
TOTAL OM&M COSTS (rounded):		**$**	**709,000**
TOTAL PROJECT COSTS (UNADJUSTED FOR NPV):		**$**	**877,000**

O&M NPV ANALYSIS

Sub-Total OM&M (30 Years, from next table): $180,900

O&M COST MARKUPS			
Contingency	20%	$	36,180
Project Management	10%	$	18,090
Remedial Design	20%	$	36,180
Construction Management	15%	$	27,135
Legal and Administrative	5%	$	9,045
EPA Oversight Fees	5%	$	9,045

TOTAL NPV OM&M COSTS: $317,000

TOTAL PRESENT VALUE PROJECT COSTS: $ 485,000

Table 4-2a

Conceptual Cost Estimate

Facility Soil Remedial Alternative #2: Limited Additional Action NPV

Shieldalloy Metallurgical Superfund Site; Newfield, NJ

YEAR	CAPITAL COST	OM&M COSTS (W/CONTINGENCY)						Total Annual Cost (Not Adjusted for Inflation)	PRESENT VALUE (AT 7% DISCOUNT RATE)
		Annual OM&M			Periodic OM&M				
		FENCE INSPECTIONS AND REPAIR			CAP/COVER INSPECTIONS AND REPAIR	5-Year Review	Monitoring		
0	**$ 168,000**	$ -		$ -	$ -	$ -			**$ 168,000**
1		$ 1,978			$ 10,200		1,000	$ 14,000	$13,084
2		$ 1,978			$ 10,200		1,000	$ 14,000	$12,228
3		$ 1,978			$ 10,200		1,000	$ 14,000	$11,428
4		$ 1,978			$ 10,200		1,000	$ 14,000	$10,681
5		$ 1,978			$ 10,200	$ 10,000	1,000	$ 24,000	$17,112
6		$ 1,978			$ 10,200		1,000	$ 14,000	$9,329
7		$ 1,978			$ 10,200		1,000	$ 14,000	$8,718
8		$ 1,978			$ 10,200		1,000	$ 14,000	$8,148
9		$ 1,978			$ 10,200		1,000	$ 14,000	$7,615
10		$ 1,978			$ 10,200		1,000	$ 14,000	$7,117
11		$ 1,978			$ 10,200		1,000	$ 14,000	$6,651
12		$ 1,978			$ 10,200		1,000	$ 14,000	$6,216
13		$ 1,978			$ 10,200		1,000	$ 14,000	$5,810
14		$ 1,978			$ 10,200		1,000	$ 14,000	$5,429
15		$ 1,978			$ 10,200		1,000	$ 14,000	$5,074
16		$ 1,978			$ 10,200		1,000	$ 14,000	$4,742
17		$ 1,978			$ 10,200		1,000	$ 14,000	$4,432
18		$ 1,978			$ 10,200		1,000	$ 14,000	$4,142
19		$ 1,978			$ 10,200		1,000	$ 14,000	$3,871
20		$ 1,978			$ 10,200		1,000	$ 14,000	$3,618
21		$ 1,978			$ 10,200		1,000	$ 14,000	$3,381
22		$ 1,978			$ 10,200		1,000	$ 14,000	$3,160
23		$ 1,978			$ 10,200		1,000	$ 14,000	$2,953
24		$ 1,978			$ 10,200		1,000	$ 14,000	$2,760
25		$ 1,978			$ 10,200		1,000	$ 14,000	$2,579
26		$ 1,978			$ 10,200		1,000	$ 14,000	$2,411
27		$ 1,978			$ 10,200		1,000	$ 14,000	$2,253
28		$ 1,978			$ 10,200		1,000	$ 14,000	$2,106
29		$ 1,978			$ 10,200		1,000	$ 14,000	$1,968
30		$ 1,978			$ 10,200		1,000	$ 14,000	$1,839
	7%	Discount Factor					Total Discounted OM&M Costs (rounded):		**$180,900**

Table 4-3
Conceptual Cost Estimate
Facility Soil Remedial Alternative #3: Additional Capping
Shieldalloy Metallurgical Superfund Site; Newfield, NJ

Remedial Alternative Description:
Engineered cap for targeted area in Former Storage Areas, maintain existing fence, maintain existing caps/covers, deed notice, and monitoring.

CAPITAL COSTS

Item	Estimated Quantity	Units	Unit Rate		Total Cost	
Controls						
Silt Fencing	1,350	LF	$	5	$	7,000
Cap (gravel)	4,200	CY	$	22	$	92,000
Geotextile (demarcation)	1.3	acres	$	7,600	$	10,000
Deed notice	1	LS	$	50,000	$	50,000
		Subtotal Direct Construction Costs			$	159,000
		Contingency	20%		$	31,800
		Project Management	10%		$	15,900
		Remedial Design	20%		$	31,800
		Construction Management	15%		$	23,850
		Legal and Administrative	5%		$	7,950
		EPA Oversight Fees	5%		$	7,950
		TOTAL CONSTRUCTION COSTS			**$**	**279,000**

Table 4-3

Conceptual Cost Estimate

Facility Soil Remedial Alternative #3: Additional Capping

Shieldalloy Metallurgical Superfund Site; Newfield, NJ

Remedial Alternative Description:

Engineered cap for targeted area in Former Storage Areas, maintain existing fence, maintain existing caps/covers, deed notice, and monitoring.

O&M COSTS

Item	Frequency	Quantity		Units		Rate/Cost Per Event		Total Cost	Note
Inspection/repair--all fencing	30	66	LF	LS	$	22	$	44,000	Repair 1% of the fence every year for 30 years
Inspection/repair--all caps/covers	30	0.7	acre	LS	$	15,000	$	306,000	Repair 1% of the areas every year for 30 years
Monitoring	1	30		LS	$	1,000	$	30,000	
5-year review	1	1		LS	$	10,000	$	10,000	
						Sub-Total OM&M (30 Years):	$	390,000	
				Contingency		20%	$	78,000	
				Project Management		10%	$	39,000	
				Remedial Design		20%	$	78,000	
				Construction Management		15%	$	58,500	
				Legal and Administrative		5%	$	19,500	
				EPA Oversight Fees		5%	$	19,500	
						TOTAL OM&M COSTS (rounded):	**$**	**683,000**	
						TOTAL PROJECT COSTS (UNADJUSTED FOR NPV):	**$**	**962,000**	

O&M NPV ANALYSIS

Sub-Total OM&M (30 Years, from next table):			$168,500
O&M COST MARKUPS			
Contingency	20%	$	33,700
Project Management	10%	$	16,850
Remedial Design	20%	$	33,700
Construction Management	15%	$	25,275
Legal and Administrative	5%	$	8,425
EPA Oversight Fees	5%	$	8,425
TOTAL NPV OM&M COSTS:			$295,000
TOTAL PRESENT VALUE PROJECT COSTS:		**$**	**574,000**

Table 4-3a
Conceptual Cost Estimate
Facility Soil Remedial Alternative #3: Additional Capping NPV
Shieldalloy Metallurgical Superfund Site; Newfield, NJ

		OM&M COSTS (W/CONTINGENCY)							
		Annual OM&M			Periodic OM&M				
YEAR	**CAPITAL COST**	**FENCE INSPECTIONS AND REPAIR**			**CAP/COVER INSPECTIONS AND REPAIR**	**5-Year Review**	**Monitoring**	**Total Annual Cost (Not Adjusted for Inflation)**	**PRESENT VALUE (AT 7% DISCOUNT RATE)**
0	**$ 279,000**	$ -		$ -	$ -	$ -			**$ 279,000**
1		$ 1,452			$ 10,200		1,000	$ 13,000	$12,150
2		$ 1,452			$ 10,200		1,000	$ 13,000	$11,355
3		$ 1,452			$ 10,200		1,000	$ 13,000	$10,612
4		$ 1,452			$ 10,200		1,000	$ 13,000	$9,918
5		$ 1,452			$ 10,200	$ 10,000	1,000	$ 23,000	$16,399
6		$ 1,452			$ 10,200		1,000	$ 13,000	$8,662
7		$ 1,452			$ 10,200		1,000	$ 13,000	$8,096
8		$ 1,452			$ 10,200		1,000	$ 13,000	$7,566
9		$ 1,452			$ 10,200		1,000	$ 13,000	$7,071
10		$ 1,452			$ 10,200		1,000	$ 13,000	$6,609
11		$ 1,452			$ 10,200		1,000	$ 13,000	$6,176
12		$ 1,452			$ 10,200		1,000	$ 13,000	$5,772
13		$ 1,452			$ 10,200		1,000	$ 13,000	$5,395
14		$ 1,452			$ 10,200		1,000	$ 13,000	$5,042
15		$ 1,452			$ 10,200		1,000	$ 13,000	$4,712
16		$ 1,452			$ 10,200		1,000	$ 13,000	$4,404
17		$ 1,452			$ 10,200		1,000	$ 13,000	$4,115
18		$ 1,452			$ 10,200		1,000	$ 13,000	$3,846
19		$ 1,452			$ 10,200		1,000	$ 13,000	$3,595
20		$ 1,452			$ 10,200		1,000	$ 13,000	$3,359
21		$ 1,452			$ 10,200		1,000	$ 13,000	$3,140
22		$ 1,452			$ 10,200		1,000	$ 13,000	$2,934
23		$ 1,452			$ 10,200		1,000	$ 13,000	$2,742
24		$ 1,452			$ 10,200		1,000	$ 13,000	$2,563
25		$ 1,452			$ 10,200		1,000	$ 13,000	$2,395
26		$ 1,452			$ 10,200		1,000	$ 13,000	$2,239
27		$ 1,452			$ 10,200		1,000	$ 13,000	$2,092
28		$ 1,452			$ 10,200		1,000	$ 13,000	$1,955
29		$ 1,452			$ 10,200		1,000	$ 13,000	$1,827
30		$ 1,452			$ 10,200		1,000	$ 13,000	$1,708
	7%	Discount Factor					Total Discounted OM&M Costs (rounded):		**$168,500**

Table 4-4

Conceptual Cost Estimate

Facility Soil Remedial Alternative #4: Targeted Excavation

Shieldalloy Metallurgical Superfund Site; Newfield, NJ

Remedial Alternative Description:

Excavate targeted area in Former Storage Areas, maintain existing fence, maintain existing caps/covers, deed notice, and monitoring

CAPITAL COSTS

Item	Estimated Quantity	Units	Unit Rate	Total Cost
Controls				
Silt Fencing	1,350	LF	$ 5	$ 7,000
Sheeting	13,500	SF	$ 50	$ 675,000
Excavation	21,000	CY	$ 10	$ 210,000
Disposal	29,400	ton	$ 80	$ 2,352,000
Backfill	21,000	CY	$ 22	$ 462,000
Deed notice	1	LS	$ 50,000	$ 50,000
		Subtotal Direct Construction Costs		$ 3,756,000
		Contingency	20%	$ 751,200
		Project Management	10%	$ 375,600
		Remedial Design	20%	$ 751,200
		Construction Management	15%	$ 563,400
		Legal and Administrative	5%	$ 187,800
		EPA Oversight Fees	5%	$ 187,800
		TOTAL CONSTRUCTION COSTS		**$ 6,573,000**

Table 4-4
Conceptual Cost Estimate
Facility Soil Remedial Alternative #4: Targeted Excavation
Shieldalloy Metallurgical Superfund Site; Newfield, NJ

Remedial Alternative Description:

Excavate targeted area in Former Storage Areas, maintain existing fence, maintain existing caps/covers, deed notice, and monitoring

O&M COSTS

Item	Frequency	Quantity	Units	Rate/Cost Per Event	Total Cost	Note
Inspection/repair--all fencing	30	66 LF	LS	$ 23	$ 46,000	Repair 1% of the fence every year for 30 years
Inspection/repair--all caps/covers	30	0.7 acre	LS	$ 15,000	$ 306,000	Repair 1% of the areas every year for 30 years
Monitoring	1	30	LS	$ 1,000	$ 30,000	
5-year review	1	1	LS	$ 10,000	$ 10,000	

Sub-Total OM&M (30 Years):		$	392,000
Contingency	20%	$	78,400
Project Management	10%	$	39,200
Remedial Design	20%	$	78,400
Construction Management	15%	$	58,800
Legal and Administrative	5%	$	19,600
EPA Oversight Fees	5%	$	19,600
TOTAL OM&M COSTS (rounded):		**$**	**686,000**
TOTAL PROJECT COSTS (UNADJUSTED FOR NPV):		**$**	**7,259,000**

O&M NPV ANALYSIS

Sub-Total OM&M (30 Years, from next table): $168,500

O&M COST MARKUPS

Contingency	20%	$	33,700
Project Management	10%	$	16,850
Remedial Design	20%	$	33,700
Construction Management	15%	$	25,275
Legal and Administrative	5%	$	8,425
EPA Oversight Fees	5%	$	8,425

TOTAL NPV OM&M COSTS: $295,000

Table 4-4

Conceptual Cost Estimate

Facility Soil Remedial Alternative #4: Targeted Excavation

Shieldalloy Metallurgical Superfund Site; Newfield, NJ

Remedial Alternative Description:

Excavate targeted area in Former Storage Areas, maintain existing fence, maintain existing caps/covers, deed notice, and monitoring

TOTAL PRESENT VALUE PROJECT COSTS:	**$ 6,868,000**

Table 4-4a

Conceptual Cost Estimate

Facility Soil Remedial Alternative #4: Targeted Excavation NPV

Shieldalloy Metallurgical Superfund Site; Newfield, NJ

		OM&M COSTS (W/CONTINGENCY)							
		Annual OM&M			Periodic OM&M				
YEAR	CAPITAL COST	FENCE INSPECTIONS AND REPAIR			CAP/COVER INSPECTIONS AND REPAIR	5-Year Review	Monitoring	Total Annual Cost (Not Adjusted for Inflation)	PRESENT VALUE (AT 7% DISCOUNT RATE)
0	**$ 6,573,000**	$ -		$ -	$ -	$ -			**$ 6,573,000**
1		$ 1,452			$ 10,200		1,000	$ 13,000	$12,150
2		$ 1,452			$ 10,200		1,000	$ 13,000	$11,355
3		$ 1,452			$ 10,200		1,000	$ 13,000	$10,612
4		$ 1,452			$ 10,200		1,000	$ 13,000	$9,918
5		$ 1,452			$ 10,200	$ 10,000	1,000	$ 23,000	$16,399
6		$ 1,452			$ 10,200		1,000	$ 13,000	$8,662
7		$ 1,452			$ 10,200		1,000	$ 13,000	$8,096
8		$ 1,452			$ 10,200		1,000	$ 13,000	$7,566
9		$ 1,452			$ 10,200		1,000	$ 13,000	$7,071
10		$ 1,452		f	$ 10,200		1,000	$ 13,000	$6,609
11		$ 1,452			$ 10,200		1,000	$ 13,000	$6,176
12		$ 1,452			$ 10,200		1,000	$ 13,000	$5,772
13		$ 1,452			$ 10,200		1,000	$ 13,000	$5,395
14		$ 1,452			$ 10,200		1,000	$ 13,000	$5,042
15		$ 1,452			$ 10,200		1,000	$ 13,000	$4,712
16		$ 1,452			$ 10,200		1,000	$ 13,000	$4,404
17		$ 1,452			$ 10,200		1,000	$ 13,000	$4,115
18		$ 1,452			$ 10,200		1,000	$ 13,000	$3,846
19		$ 1,452			$ 10,200		1,000	$ 13,000	$3,595
20		$ 1,452			$ 10,200		1,000	$ 13,000	$3,359
21		$ 1,452			$ 10,200		1,000	$ 13,000	$3,140
22		$ 1,452			$ 10,200		1,000	$ 13,000	$2,934
23		$ 1,452			$ 10,200		1,000	$ 13,000	$2,742
24		$ 1,452			$ 10,200		1,000	$ 13,000	$2,563
25		$ 1,452			$ 10,200		1,000	$ 13,000	$2,395
26		$ 1,452			$ 10,200		1,000	$ 13,000	$2,239
27		$ 1,452			$ 10,200		1,000	$ 13,000	$2,092
28		$ 1,452			$ 10,200		1,000	$ 13,000	$1,955
29		$ 1,452			$ 10,200		1,000	$ 13,000	$1,827
30		$ 1,452			$ 10,200		1,000	$ 13,000	$1,708

7% Discount Factor

Total Discounted OM&M Costs (rounded): **$168,500**

Table 5-1
Conceptual Cost Estimate
Hudson Branch Remedial Alternative #1: No Action
Shieldalloy Metallurgical Superfund Site; Newfield, NJ

Remedial Alternative Description:

No action. Used as baseline for comparison of other alternatives, as required by Superfund.

CAPITAL COSTS

Item	Estimated Quantity	Units	Unit Rate	Total Cost	
Controls					
None	-	ft	$ -	$ -	
		Subtotal Direct Construction Costs		$ -	
		Contingency	20%	$ -	
		Project Management	10%	$ -	
		Remedial Design	20%	$ -	
		Construction Management	15%	$ -	
		Legal and Administrative	5%	$ -	
		EPA Oversight Fees	5%	$ -	
		TOTAL CONSTRUCTION COSTS		**$ -**	Cost for "No Action" is zero dollars

Table 5-1
Conceptual Cost Estimate
Hudson Branch Remedial Alternative #1: No Action
Shieldalloy Metallurgical Superfund Site; Newfield, NJ

Remedial Alternative Description:

No action. Used as baseline for comparison of other alternatives, as required by Superfund.

O&M COSTS

Item	Frequency	Quantity	Units	Rate/Cost Per Event	Total Cost	Note
5 year review	1	1	LS	$ 10,000	$ 10,000	
			Sub-Total OM&M (30 Years):		$ 10,000	
			Contingency	20%	$ 2,000	
			Project Management	10%	$ 1,000	
			Remedial Design	20%	$ 2,000	
			Construction Management	15%	$ 1,500	
			Legal and Administrative	5%	$ 500	
			EPA Oversight Fees	5%	$ 500	
			TOTAL OM&M COSTS:		**$ 17,500**	
			TOTAL PROJECT COSTS (UNADJUSTED FOR NPV):		**$ 17,500**	

O&M NPV ANALYSIS

Sub-Total OM&M (30 Years):			$12,500
O&M COSTS			
Contingency	20%	$	2,500
Project Management	10%	$	1,250
Remedial Design	20%	$	2,500
Construction Management	15%	$	1,875
Legal and Administrative	5%	$	625
EPA Oversight Fees	5%	$	625
TOTAL NPV OM&M COSTS:			$22,000
TOTAL PRESENT VALUE PROJECT COSTS:		**$**	**22,000**

Table 5-1
Conceptual Cost Estimate
Hudson Branch Remedial Alternative #1: No Action
Shieldalloy Metallurgical Superfund Site; Newfield, NJ

Remedial Alternative Description:
No action. Used as baseline for comparison of other alternatives, as required by Superfund.

CAPITAL COSTS

Item	Estimated Quantity	Units	Unit Rate	Total Cost	
Controls					
None	-	ft	$ -	$ -	
		Subtotal Direct Construction Costs		$ -	
		Contingency	20%	$ -	
		Project Management	10%	$ -	
		Remedial Design	20%	$ -	
		Construction Management	15%	$ -	
		Legal and Administrative	5%	$ -	
		EPA Oversight Fees	5%	$ -	
		TOTAL CONSTRUCTION COSTS		**$ -**	Cost for "No Action" is zero dollars

Table 5-1

Conceptual Cost Estimate

Hudson Branch Remedial Alternative #1: No Action

Shieldalloy Metallurgical Superfund Site; Newfield, NJ

Remedial Alternative Description:

No action. Used as baseline for comparison of other alternatives, as required by Superfund.

O&M COSTS

Item	Frequency	Quantity	Units	Rate/Cost Per Event	Total Cost	Note
5 year review	1	1	LS	$ 10,000	$ 10,000	
				Sub-Total OM&M (30 Years):	$ 10,000	
			Contingency	20%	$ 2,000	
			Project Management	10%	$ 1,000	
			Remedial Design	20%	$ 2,000	
			Construction Management	15%	$ 1,500	
			Legal and Administrative	5%	$ 500	
			EPA Oversight Fees	5%	$ 500	
				TOTAL OM&M COSTS:	**$ 17,500**	
				TOTAL PROJECT COSTS (UNADJUSTED FOR NPV):	**$ 17,500**	

O&M NPV ANALYSIS

Sub-Total OM&M (30 Years):		$12,500
O&M COSTS		
Contingency	20%	$ 2,500
Project Management	10%	$ 1,250
Remedial Design	20%	$ 2,500
Construction Management	15%	$ 1,875
Legal and Administrative	5%	$ 625
EPA Oversight Fees	5%	$ 625
TOTAL NPV OM&M COSTS:		$22,000
TOTAL PRESENT VALUE PROJECT COSTS:		**$ 22,000**

Table 5-2

Conceptual Cost Estimate

Hudson Branch Remedial Alternative #2: Limited Action

Shieldalloy Metallurgical Superfund Site; Newfield, NJ

Remedial Alternative Description:

Fencing and monitoring.

CAPITAL COSTS

Item	Estimated Quantity	Units	Unit Rate	Total Cost
Controls				
Fencing	6,000	ft	$ 23	$ 138,000
		Subtotal Direct Construction Costs		$ 138,000
		Contingency	20%	$ 27,600
		Project Management	10%	$ 13,800
		Remedial Design	20%	$ 27,600
		Construction Management	15%	$ 20,700
		Legal and Administrative	5%	$ 6,900
		EPA Oversight Fees	5%	$ 6,900
		TOTAL CONSTRUCTION COSTS		**$ 242,000**

Table 5-2

Conceptual Cost Estimate

Hudson Branch Remedial Alternative #2: Limited Action

Shieldalloy Metallurgical Superfund Site; Newfield, NJ

Remedial Alternative Description:

Fencing and monitoring.

O&M COSTS

Item	Frequency	Quantity	Units	Rate/Cost Per Event	Total Cost	Note
Fence Inspection and repair	1	30	LS	$ 6,900	$ 207,000	Repair 5% of the fence every year for 30 years
Hudson Branch Monitoring	1	30	LS	$ 10,000	$ 300,000	
5-year review	1	1	LS	$ 10,000	$ 10,000	
				Sub-Total OM&M (30 Years):	$ 517,000	
			Contingency	20%	$ 103,400	
			Project Management	10%	$ 51,700	
			Remedial Design	20%	$ 103,400	
			Construction Management	15%	$ 77,550	
			Legal and Administrative	5%	$ 25,850	
			EPA Oversight Fees	5%	$ 25,850	
				TOTAL OM&M COSTS:	**$ 904,750**	
				TOTAL PROJECT COSTS (UNADJUSTED FOR NPV):	**$ 1,146,750**	

O&M NPV ANALYSIS

Sub-Total OM&M (30 Years, from next table):			$219,000
O&M COST MARKUPS			
Contingency	20%	$	43,800
Project Management	10%	$	21,900
Remedial Design	20%	$	43,800
Construction Management	15%	$	32,850
Legal and Administrative	5%	$	10,950
EPA Oversight Fees	5%	$	10,950
TOTAL NPV OM&M COSTS:			$384,000
TOTAL PRESENT VALUE PROJECT COSTS:		**$**	**626,000**

Table 5-2a

Conceptual Cost Estimate

Hudson Branch Remedial Alternative #2: Limited Action NPV

Shieldalloy Metallurgical Superfund Site; Newfield, NJ

		OM&M COSTS (W/CONTINGENCY)							
		Annual OM&M			Periodic OM&M				
YEAR	**CAPITAL COST**				**FENCE INSPECTIONS AND REPAIR**	**5-Year Review**	**Monitoring**	**Total Annual Cost (Not Adjusted for Inflation)**	**PRESENT VALUE (AT 7% DISCOUNT RATE)**
0	**$ 242,000**	$ -		$ -	$ -	$ -			**$ 242,000**
1					$ 6,900		10,000	$ 17,000	$15,888
2					$ 6,900		10,000	$ 17,000	$14,848
3					$ 6,900		10,000	$ 17,000	$13,877
4					$ 6,900		10,000	$ 17,000	$12,969
5					$ 6,900	$ 10,000	10,000	$ 27,000	$19,251
6					$ 6,900		10,000	$ 17,000	$11,328
7					$ 6,900		10,000	$ 17,000	$10,587
8					$ 6,900		10,000	$ 17,000	$9,894
9					$ 6,900		10,000	$ 17,000	$9,247
10					$ 6,900		10,000	$ 17,000	$8,642
11					$ 6,900		10,000	$ 17,000	$8,077
12					$ 6,900		10,000	$ 17,000	$7,548
13					$ 6,900		10,000	$ 17,000	$7,054
14					$ 6,900		10,000	$ 17,000	$6,593
15					$ 6,900		10,000	$ 17,000	$6,162
16					$ 6,900		10,000	$ 17,000	$5,758
17					$ 6,900		10,000	$ 17,000	$5,382
18					$ 6,900		10,000	$ 17,000	$5,030
19					$ 6,900		10,000	$ 17,000	$4,701
20					$ 6,900		10,000	$ 17,000	$4,393
21					$ 6,900		10,000	$ 17,000	$4,106
22					$ 6,900		10,000	$ 17,000	$3,837
23					$ 6,900		10,000	$ 17,000	$3,586
24					$ 6,900		10,000	$ 17,000	$3,351
25					$ 6,900		10,000	$ 17,000	$3,132
26					$ 6,900		10,000	$ 17,000	$2,927
27					$ 6,900		10,000	$ 17,000	$2,736
28					$ 6,900		10,000	$ 17,000	$2,557
29					$ 6,900		10,000	$ 17,000	$2,390
30					$ 6,900		10,000	$ 17,000	$2,233
		7% Discount Factor					Total Discounted OM&M Costs (rounded):		**$218,100**

Table 5-3
Conceptual Cost Estimate
Hudson Branch Remedial Alternative #3: Complete Excavation
Shieldalloy Metallurgical Superfund Site; Newfield, NJ

Remedial Alternative Description:
Excavate to full depths/dispose/backfill/restore.

CAPITAL COST

Item	Estimated Quantity	Units	Unit Price		Cost	
Temporary Items						
Temporary Fencing	7,200	LF	$	16	$	113,400
Mobilization/Demobilization	8	per event	$	50,000	$	400,000
Silt Fencing	7,200	LF	$	5	$	36,000
Water Pumping/Treatment/Facilities	7	month	$	50,000	$	350,000
Tempoary Construction Roads/Access	6,000	ft	$	31	$	186,000
Excavation						
Clearing and Grubbing	4.9	acre	$	7,000	$	34,300
Excavation	9,600	cy	$	30	$	288,000
Handling/drying	9,600	cy	$	5	$	48,000
Stabilization (assumed % to render it non-haz)	960	cy	$	60	$	57,600
10%						
Offsite Transportation and Disposal	13,400	ton	$	80	$	1,072,000
Backfill/Restoration						
Fill	5,600	cy	$	31	$	173,600
Top Soil	4,000	cy	$	45	$	180,000
Seeding and planting	4.9	acre	$	20,000	$	98,000
Erosion Mats	4.9	acres	$	17,000	$	83,300
			Subtotal Direct Construction Costs		$	3,121,000
		Contingency	25%		$	780,250
		Project Management	20%		$	624,200
		Remedial Design	20%		$	624,200
		Engineering and Construction Management	10%		$	312,100
		Legal and Administrative	5%		$	156,050
		EPA Oversight Fees	5%		$	156,050
			TOTAL CONSTRUCTION COSTS (rounded)		**$**	**5,774,000**

Table 5-3

Conceptual Cost Estimate

Hudson Branch Remedial Alternative #3: Complete Excavation

Shieldalloy Metallurgical Superfund Site; Newfield, NJ

Remedial Alternative Description:

Excavate to full depths/dispose/backfill/restore.

O&M Costs

Item	Frequency	Quantity	Units	Rate/Cost Per Event	Total Cost	Note
Annual inspection	5 years	5	LS	$ 10,000	$ 50,000	
Repair	5 Years	5	LS	$ 20,000	$ 100,000	
5-year review	1	1	LS	$ 10,000	$ 10,000	
Monitoring		-	LS	$ -	$ -	
			Sub-Total OM&M (30 Years):		$ 160,000	
		Contingency		20%	$ 32,000	
		Project Management		10%	$ 16,000	
		Remedial Design		15%	$ 24,000	
		Construction Management		10%	$ 16,000	
		Legal and Administrative		5%	$ 8,000	
		EPA Oversight Fees		5%	$ 8,000	
			TOTAL OM&M COSTS:		**$ 264,000**	
	TOTAL PROJECT COSTS (UNADJUSTED For NPV):				**$ 6,038,000**	

NPV ANALYSIS

Sub-Total OM&M (30 Years from next table):		$	123,000
O&M COST MARKUPS			
Contingency	20%	$	24,600
Project Management	10%	$	12,300
Remedial Design	15%	$	18,450
Construction Management	10%	$	12,300
Legal and Administrative	5%	$	6,150
EPA Oversight Fees	5%	$	6,150
TOTAL OM&M COSTS:		$	203,000
TOTAL PRESENT VALUE PROJECT COSTS:		**$**	**5,977,000**

Table 5-3a
Conceptual Cost Estimate
Hudson Branch Remedial Alternative #3: Complete Excavation NPV
Shieldalloy Metallurgical Superfund Site; Newfield, NJ

YEAR	CAPITAL COST	OM&M COSTS (W/CONTINGENCY) Annual OM&M			Periodic OM&M Inspections	Repairs		Total Annual Cost (Not Adjusted for Inflation)	PRESENT VALUE (AT 7% DISCOUNT RATE)
0	**$ 5,774,000**			$ -		$ -			**$ 5,774,000**
1					$ 10,000	$ 20,000		$ 30,000	$28,037
2					$ 10,000	$ 20,000	$ -	$ 30,000	$26,203
3					$ 10,000	$ 20,000		$ 30,000	$24,489
4					$ 10,000	$ 20,000	$ -	$ 30,000	$22,887
5					$ 10,000	$ 20,000		$ 30,000	$21,390
6							$ -	$ -	$0
7								$ -	$0
8							$ -	$ -	$0
9								$ -	$0
10							$ -	$ -	$0
11								$ -	$0
12							$ -	$ -	$0
13								$ -	$0
14							$ -	$ -	$0
15						$ -		$ -	$0
16							$ -	$ -	$0
17								$ -	$0
18							$ -	$ -	$0
19								$ -	$0
20						$ -	$ -	$ -	$0
21								$ -	$0
22							$ -	$ -	$0
23								$ -	$0
24							$ -	$ -	$0
25						$ -		$ -	$0
26							$ -	$ -	$0
27								$ -	$0
28							$ -	$ -	$0
29								$ -	$0
30						$ -	$ -	$ -	$0

7% Discount Factor

Total Unadjusted Costs: $ 150,000

Total Discounted OM&M Costs (rounded): **$123,000**

R2-0003392

Table 5-4

Conceptual Cost Estimate

Hudson Branch Remedial Alternative #4: Excavation/Capping

Shieldalloy Metallurgical Superfund Site; Newfield, NJ

Remedial Alternative Description:

Targeted Excavation/dispose/backfill, engineered cap, monitor.

CAPITAL COST

Item	Estimated Quantity	Units	Unit Price		Cost	
Temporary Items						
Temporary Fencing	6,000	LF	$	11	$	67,500
Mobilization/Demobilization	4	per event	$	50,000	$	200,000
Silt Fencing	6,000	LF	$	5	$	30,000
Water Pumping/Treatment/Facilities	5	month	$	50,000	$	250,000
Tempoary Construction Roads/Access	5,000	ft	$	31	$	155,000
Excavation						
Clearing and Grubbing	4.7	acre	$	7,000	$	32,900
Excavation	8,500	cy	$	30	$	255,000
Handling/drying	8,500	cy	$	5	$	42,500
Stabilization (assumed % to render it non-haz) 10%	850	cy	$	60	$	51,000
Offsite Transportation and Disposal	11,900	ton	$	80	$	952,000
Backfill/Restoration						
Fill	4,500	cy	$	31	$	139,500
Top Soil	4,000	cy	$	45	$	180,000
Seeding	4.7	acre	$	5,000	$	24,000
Erosion Mats	4.7	acres	$	17,000	$	79,900
		Subtotal Direct Construction Costs			$	2,460,000
		Contingency	20%		$	492,000
		Project Management	15%		$	369,000
		Remedial Design	15%		$	369,000
		Engineering and Construction Management	10%		$	246,000
		Legal and Administrative	5%		$	123,000
		EPA Oversight Fees	5%		$	123,000
		TOTAL CONSTRUCTION COSTS (rounded)			**$**	**4,182,000**

Table 5-4

Conceptual Cost Estimate

Hudson Branch Remedial Alternative #4: Excavation/Capping

Shieldalloy Metallurgical Superfund Site; Newfield, NJ

Remedial Alternative Description:

Targeted Excavation/dispose/backfill, engineered cap, monitor.

O&M Costs

Item	Frequency	Quantity	Units	Rate/Cost Per Event	Total Cost	Note
Annual inspection	5 years	5	LS	$ 10,000	$ 50,000	
Repair	5 Years	5	LS	$ 20,000	$ 100,000	
5-year review	1	1	LS	$ 10,000	$ 10,000	
Monitoring	2 years for decade, then 5 years	10	LS	$ 2,000	$ 20,000	
				Sub-Total OM&M (30 Years):	$ 180,000	
			Contingency	20%	$ 36,000	
			Project Management	15%	$ 27,000	
			Remedial Design	15%	$ 27,000	
			Construction Management	10%	$ 18,000	
			Legal and Administrative	5%	$ 9,000	
			EPA Oversight Fees	5%	$ 9,000	
				TOTAL OM&M COSTS:	**$ 306,000**	
				TOTAL PROJECT COSTS (UNADJUSTED For NPV):	**$ 4,488,000**	

NPV ANALYSIS

Sub-Total OM&M (30 Years from next table):		$	123,000
O&M COST MARKUPS			
Contingency	20%	$	24,600
Project Management	10%	$	12,300
Remedial Design	20%	$	24,600
Construction Management	15%	$	18,450
Legal and Administrative	5%	$	6,150
EPA Oversight Fees	5%	$	6,150
TOTAL OM&M COSTS:		$	216,000
TOTAL PRESENT VALUE PROJECT COSTS:		**$**	**4,398,000**

Table 5-4a

Conceptual Cost Estimate

Hudson Branch Remedial Alternative #4: Excavation/Capping NPV

Shieldalloy Metallurgical Superfund Site; Newfield, NJ

YEAR	CAPITAL COST	OM&M COSTS (W/CONTINGENCY) Annual OM&M: Five Year Review			Periodic OM&M: Inspections	Repairs	Monitoring	Total Annual Cost (Not Adjusted for Inflation)	PRESENT VALUE (AT 7% DISCOUNT RATE)
0	**$ 5,774,000**			$ -		$ -			**$ 5,774,000**
1					$ 10,000	$ 20,000		$ 30,000	$28,037
2					$ 10,000	$ 20,000	$ 2,000	$ 32,000	$27,950
3					$ 10,000	$ 20,000		$ 30,000	$24,489
4					$ 10,000	$ 20,000	$ 2,000	$ 32,000	$24,413
5		$ 10,000			$ 10,000	$ 20,000		$ 40,000	$28,519
6							$ 2,000	$ 2,000	$1,333
7								$ -	$0
8							$ 2,000	$ 2,000	$1,164
9								$ -	$0
10							$ 2,000	$ 2,000	$1,017
11								$ -	$0
12								$ -	$0
13								$ -	$0
14								$ -	$0
15						$ -	$ 2,000	$ 2,000	$725
16								$ -	$0
17								$ -	$0
18								$ -	$0
19								$ -	$0
20						$ -	$ 2,000	$ 2,000	$517
21								$ -	$0
22								$ -	$0
23								$ -	$0
24								$ -	$0
25						$ -	$ 2,000	$ 2,000	$368
26								$ -	$0
27								$ -	$0
28								$ -	$0
29								$ -	$0
30						$ -	$ 2,000	$ 2,000	$263
		7% Discount Factor					Total Unadjusted Costs:	$ 178,000	
							Total Discounted OM&M Costs (rounded):		**$138,800**

Appendix A
Treatability Study : TCLP Results
Shieldalloy Metallurgical Corporation Superfund Site
Newfield, NJ

	Sample ID:	TS-1S	TS-1B	TS-2S	TS-2B	TS-3S	TS-3B
	Sample Date:	4/17/2013	4/17/2013	4/17/2013	4/17/2013	4/17/2013	4/17/2013
Analysis	**Units**						
pH	s.u.	5.14	5.08	5.19	5.15	5.08	5.09
Metals	**Units**						
Ag	mg/L	ND	ND	ND	ND	ND	ND
As	mg/L	0.2	0.14	0.23	<0.13	0.13	0.29
Cd	mg/L	ND	ND	ND	ND	ND	ND
Cr_{total}	mg/L	ND	ND	ND	ND	ND	ND
Cr(VI)	mg/L	ND	ND	ND	ND	ND	ND
Ni	mg/L	0.34	ND	2	1.8	ND	0.34
Pb	mg/L	ND	ND	ND	ND	ND	ND
V	mg/L	0.61	ND	6.8	3.6	ND	0.76

Note: Samples of channel sediments denoted by suffix "S" (e.g. TS-1S)

Samples of wetland sediments near stream bank denoted by suffix "B" (e.g. TS-1B)

Analyses performed by TRC Wet Chemistry Laboratory (Madison, WI)